CommPlete™
COMMUNICATIONS SERVER

MT5634HD8/16 User Guide

MultiTech® Systems

MT5634HD8/16 User Guide

P/N 82074700, Revision A

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Federal Communications Commission Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Regulations for Telephone Line Interconnection

1. No repairs are to be made by you. Repairs are to be made only by Multi-Tech Systems or its licensees. Unauthorized repairs void registration and warranty. Contact Multi-Tech Systems, Inc. for details of how to have repairs made.
2. When trouble is experienced, you must disconnect your modem from the telephone company's jack to determine the cause of the trouble, and reconnect your modem only when the trouble is corrected.
3. The modem cannot be connected to pay telephones or party lines.
4. If requested by the telephone company, you must notify them of the following before the MT5634HD8/16 is installed:
    a. The particular phone line (phone number) to which the connection is to be made.
    b. The FCC Registration Number. (See your CC9600 Chassis User Guide for specifics.)
    c. The manufacturer's name and model number:

    Multi-Tech Systems - Model MT5634HD8 or MT5634HD16
5. If the telephone company notifies you that your device is causing harm, unplug it. The telephone company may disconnect your service if necessary and also may change its facilities, equipment, operations or procedures which may affect operation of your equipment. Where practical, the telephone company must promptly inform you in writing of the temporary disconnect or change in service, give you the opportunity to make changes allowing uninterrupted service, and inform you of your rights to bring a complaint to the FCC.

FCC Fax Warning

The Telephone Consumer Protection Act of 1991 makes it unlawful for any person to use a computer or other electronic device to send any message via a telephone fax machine unless such message clearly contains in a margin at the top or bottom of each page or the first page of the transmission, the date and time it is sent and an identification of the business or other entity, or other individual sending the message and the telephone number of the sending machine or such business, other entity, or individual.

See your fax software manual for setup details.

Canadian Limitations Notice

Notice: The ringer equivalence number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination of a interface may consist of any combination of devices subject only to the requirement that the sum of the ringer equivalence numbers of all the devices does not exceed 5.

Notice: The Industry Canada label identifies certificated equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. Industry Canada does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

See your CC9600 User Guide for complete Canadian Limitations information.

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1 Introduction

Introduction

The Multi-Tech MT5634HD8 and MT5634HD16 are high speed, high density modem cards for the CommPlete Communications Server. Each MT5634HD8 contains eight integrated 56Kflex modems, and each MT5634HD16 card contains sixteen integrated 56Kflex modems. Each modem on the card can be configured independently of the others via RASexpress Software or the CommPlete Communications Server's MR9600 controller. The MT5634HD8/16 cards can be used in various combinations according to the desired segment type; T1, PRI or Dual T1. There are no external connectors.

Three MT5634HD8 card must be installed per T1 segment. With eight modems per card, the CommPlete Communications Server can support up to 24 simultaneous data line per segment.

One MT5634HD16 card and one MT5634HD8 card must be installed per PRI segment. With sixteen modems per MT5634HD16 card and eight modems per MT5634HD8 card, the CommPlete Communications Server can support up to 24 simultaneous data lines per segment. Analog calls are routed to the MT5634HD16's modems through a Primary Rate Interface (PRI) card which plugs into the slot next to the RASCard that controls the segment. ISDN calls are routed to the PRI where its "B" channel(s) process the call.

Three MT5634HD16 cards must be installed per Dual T1 segment. With sixteen modems per MT5634HD16 card the CommPlete Communications Server can support up to 48 simultaneous data lines per segment.

The MT5634HD8/16 operates as an enhanced ITU-T V.34 dial-up modem with a maximum K56flex speeds, and is a fully digital K56flex server. As such, it includes the advanced features of other popular Multi-Tech standalone modems.

The MT5634HD8/16 is registered by the FCC for direct connection to the public telephone networks. No Data Access Arrangements (DAAs) are required.

The MT5634HD8/16 is fully compatible with the standard AT command set, and is therefore compatible with all popular communications software packages.

This user guide will help you to install, configure, test, and use the MT5634HD8/16.

Manual Organization

Chapter 1 Introduction

This chapter describes the MT5634HD8/16 and its LED indicators, gives its technical specifications, and provides a guide to the organization of the manual.

Chapter 2 Installation

This chapter describes how to install the MT5634HD8/16 into the CC9600 chassis.

Chapter 3 Command Mode Operation

This chapter provides an introduction to MT5634HD8/16 command mode fundamentals, followed by a detailed explanation of each AT command, providing examples where applicable.

Chapter 4 S-Registers

This chapter describes the MT5634HD8/16's S-registers, which are used to store various modem options.

LED Indicators

The MT5634HD8 has 16 LED indicators (the MT5634HD16 has 32 LEDs) on the front panel, two for each modem:

CD **Carrier Detect.** The CD LED lights when the modem detects a valid carrier signal.

OH **Off Hook/Out of Service.** The OH LED lights when the modem is off hook, which occurs when the modem is dialing, online, or answering a call. The LED flashes when the modem is in the busy-out or out-of-service state.

Power Supplies

DC voltages are supplied to all modems in the CC9600 rack through two PS9600 universal input switching power supplies designed for conventional 115 or 230 VAC input. The power supplies are designed for redundant, fail-safe operation. If one should fail, the other can supply the power requirements of the entire CommPlete Communications Server. Each PS9600 power supply has one LED indicator that indicates the presence of all supply voltages.

Technical Specifications

Model Numbers	MT5634HD8 and MT5634HD16
Data Rates (Modem)	Eight or sixteen independent modems (Modem A, B, C, D, E, F, G, H), each operating as follows: Downloads at speeds to 56K bps when calling a fully digital K56flex server (actual connect speed depends on line conditions). Uploads and other connections at 33,600, 31,200, 28,800, 26,400, 24,000, 21,600, 19,200, 16,800, 14,400, 12,000, 9600, 4800, 2400, 1200, or 0-300 bps
Data Rates (Fax)	14,400, 9600, 4800, and 2400 bps
Data Format (Modem)	Serial, binary, asynchronous at all data rates
Configuration	Each of the card's modems is independently configurable
Compatibility (Modem)	ITU-T V.42bis, V.42, V.34, ITU-T V.32bis, V.32, V.25bis, V.21, V.22bis, V.22, V.23, V.17, Bell 212A* and 103/113*, K56flex
Compatibility (Fax)	ITU-T Group 3, T.4, T.30, V.21, V.27ter, V.29, V.17, and EIA TR29.2
Error Correction	ITU-T V.42 (MNP® Classes 3 and 4, and LAP-M)
Data Compression	ITU-T V.42bis (4:1 throughput) or MNP 5 (2:1 throughput)
Speed Conversion	Serial port data rates adjustable to 300, 1200, 2400, 4800,9600, 19,200, 38,400, 57,600, and 115,200 bps
Flow Control	XON/XOFF, CTS/RTS
Mode of Operation	Half or full duplex over dial-up lines; automatic or manual dialing, automatic or manual answer
Intelligent Features	Fully AT command compatible; auto dial; redial; repeat dial*; pulse or tone dial; dial pauses; call status display; auto-parity and data rate selection; keyboard-controlled modem options; nonvolatile memory; on-screen displays of modem parameters, stored telephone numbers, and help menus.
AT Commands	100% compatible with standard AT command set
Command Buffer	40 characters
Automatic Dialing	Standard AT command asynchronous dialing
Modem Modulations	FSK at 300 bps, PSK at 1200 bps, QAM at 2400, 4800, and 9600 bps (non-trellis), QAM with trellis-coded modulation (TCM) at 9600, 12,000, 14,400, 16,800, 19,200, 21,600, 24,000, 26,400, 28,800, 31,200, 33,600, plus K56flex speeds
Fax Modulations	V.21 CH2 FSK at 300 bps V.27ter DPSK at 4800 and 2400 bps V.29 QAM at 9600 and 7200 bps V.17TCM at 14400, 12000, 9600, and 7200 bps
Carrier Frequencies ITU-T V.34	1600, 1646, 1680, 1800, 1829, 1867, 1920, 1959, 2000 Hz
Carrier Frequencies: AT&T V.32terbo/	1800 Hz

ITU-T V.32bis/V.32

Carrier Frequencies: V.22bis/V.22 or Bell 212A Standard (2400 & 1200 bps)	Transmit originate:	1200 Hz
	Transmit answer:	2400 Hz
	Receive originate:	2400 Hz
	Receive answer:	1200 Hz
Carrier Frequencies: Bell 103/113 (300 bps)	Transmit originate:	1270 Hz mark 1070 Hz space
	Receive originate:	2225 Hz mark 2025 Hz space
	Transmit answer:	2225 Hz mark 2025 Hz space
	Receive answer:	1270 Hz mark 1070 Hz space
Carrier Frequencies: V.21	Transmit originate:	980 Hz mark 1180 Hz space
	Receive originate:	1650 Hz mark 1850 Hz space
	Transmit answer:	1650 Hz mark 1850 Hz space
	Receive answer:	980 Hz mark 1180 Hz space
Carrier Frequencies: V.23	Transmit originate:	390 Hz mark 450 Hz space
	Receive originate:	1300 Hz mark 2100 Hz space
	Transmit answer:	1300 Hz mark 2100 Hz space
	Receive answer:	390 Hz mark 450 Hz space

Fax Modulations	V.21Ch2 FSK at 300 bps V.27ter DPSK at 4800 and 2400 bps V.29 QAM at 9600 and 7200 bps V.17 TCM at 14400, 12000, 9600, and 7200 bps
Fax Carrier Frequencies	V.21 CH2 (half duplex) 1650 Hz mark, 1850 Hz space for transmit originate 1650 Hz mark, 1850 Hz space for transmit answer V.27ter: 1800 Hz Originate/Answer V.29 QAM: 1700 Hz Originate/Answer V.17 TCM: 1800 Hz Originate/Answer
Transmit Level	-13 dBm
Frequency Stability	+0.01%
Receiver Sensitivity	-43 dBm under worst case conditions
AGC Dynamic Range	43 dB
Interface	TIA / EIA RS-232/ITU-T V.24/V.28
Diagnostics	Power-on self-test, local analog loop, local digital loop, remote digital loop.

Firmware Upgrades	Flash memory; available on Multi-Tech's BBS and website
Indicators	LEDs for Carrier Detect and Off Hook/Out-Of-Service
Environmental	Temperature range: 0°–50° C (32°–120° F) Humidity range: 20–90% (noncondensing)
Power Requirements:	
MT5634HD8	5 VDC at 1.5 A (MT5634HD8)
MT5634HD16	5 VDC at 3.0 A (MT5634HD16)
Dimensions	23.3 × 2.3 × 29.2 cm (9.2 × 0.9 × 11.5 in.) H × W × D
Weight:	
MT5634HD8	14 oz.
MT5634HD16	1 lb.
Limited Warranty	Two years

2 Installation

Introduction

This chapter describes how to install the MT5634HD8/16 modem card into a CommPlete Communication Server CC9600 chassis. This equipment should be installed only by a qualified service person.

The MT5634HD8/16 assembly consists of a high-density modem card and a front panel. Figure 1 shows the layout of the MT5634HD16 card (the MT5634HD8 card is not shown). The MT5634HD8/16 assembly plugs into power and data, Ethernet, and T1 bus connectors on the inside of the CC9600 chassis. There are no external connectors.

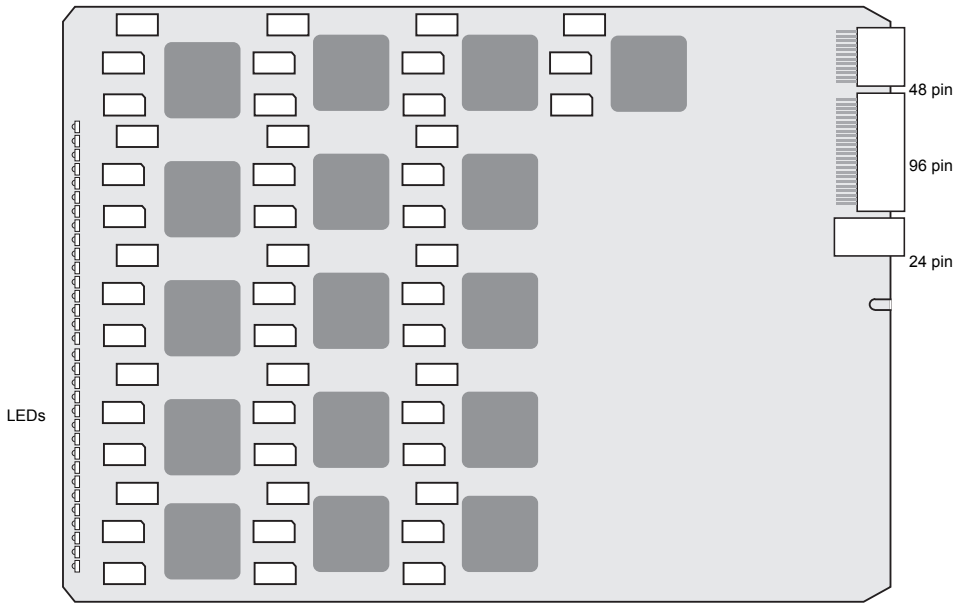

Figure 1. MT5634HD16 modem card.

Safety Warnings

- ✔ Never install telephone wiring during a lightning storm.
- ✔ Never install telephone jacks in wet locations unless the jacks are specifically designed for wet locations.
- ✔ Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.
- ✔ Use caution when installing or modifying telephone lines.
- ✔ Avoid using a telephone (other than a cordless type) during an electrical storm. There may be a remote risk of electrical shock from lightning.
- ✔ Do not use the telephone to report a gas leak in the vicinity of that leak.
- ✔ Ports that are connected to other apparatus are defined as SELV. To ensure conformity to EN 41003, ensure that these ports are only connected to the same type on the other apparatus.

Pre-Installation Notes

Warning: Direct interconnection (or connection by way of other apparatus) of ports marked "**SAFETY WARNING see instructions for use**" with any other ports (whether or not similarly marked) may produce hazardous conditions on the network.

MultiTech strongly urges you to consult a qualified engineer before attempting to make this type of connection.

- All installation must be done by a qualified service person.
- To reduce emissions, be sure to use blanking plates to cover empty slots in the CC9600 chassis.
- Cable, wiring, and any other apparatus connected between the MT5634HD8/16K modem and the point of connection to any speech band circuit shall comply with the following:
    1. The overall characteristics of the apparatus shall be such as to introduce no material effect upon the electrical conditions presented to one another by the modem and the speech band circuit.
    2. The apparatus shall comprise only
        a. apparatus approved for the purpose of connection between the modem and a speech band circuit; and
        b. cable and wiring complying with a code of practice for the installation of equipment covered by this part of BS 6328 or such other requirements as may be applicable.

Note: Such apparatus may have been approved subject to limitations in its use.

Installation Procedure

1. Unpack the MT5634HD8/16 assembly from its factory packaging. (You may wish to save the packaging for possible future use.)
2. Perform a visual inspection of the MT5634HD8/16. If you are concerned about its condition, call Technical Support for instructions.
3. The MT5634HD8/16 must be installed in a segment in which a RASCard is installed. Turn off the RAS segment where the MT5634HD8/16 will be installed. (Turn off power to this segment.)
4. Remove a blank device front panel or previous MT5634HD8/16 card from the RAS segment used in step 3. Do *not* remove the back panel.
5. Support the MT5634HD8/16 by the front panel and the bottom edge of the card, and carefully place it into the CC9600's open device slot. Make sure the edges of the MT5634HD8/16 card mate properly with the guides of the device slot.
6. Slide the MT5634HD8/16 into the CC9600 chassis until you feel the MT5634HD16's connectors mate with the CC9600's bus connectors.

7. Tighten the MT5634HD8/16's retaining screws.
8. Repeat steps 1 through 7 for each of the MT5634HD8/16's you are installing. Three MT5634HD8's must be installed for each T1 segment, three MT5634HD16's must be installed for each Dual T1 segment, and one MT5634HD16 and one MT5634HD8 must be installed for each PRI segment.
9. Turn on power to the RASCard segment.
10. Check the LED indicators on the RASCard and the controllers. If the LEDs on the controller do not light, turn off the RASCard segment. Reseat the cards by repeating steps 5 through 9. If you continue to experience problems, consult your CommPlete *Owner's Manual* for troubleshooting tips.

Note: A self-test runs each time the CommPlete Communications Server is turned on. Refer to your system *Owner's Manual* for more details on the power-on self-test.

3 AT Commands

Working with AT Commands

The MT5634HD8/16's modems are controlled by instructions called *AT commands*, so called because the attention characters *AT* precede each command or sequence of commands (known as a *command string*). You can send commands to the modem from your keyboard while in terminal mode, or you can use communications software to issue these commands automatically.

The modem is in command mode when it is not dialing or online. When it is in command mode, you have access to a complete communications system that allows you to use several features, including the basic AT command set described in this chapter. Using the basic AT command set, you can enter phone numbers for automatic dialing, configure modem options, and monitor telephone activity. In addition, you can command your modem to perform advanced features such as error correction, data compression, speed conversion, and more.

This chapter describes the modem's operational modes, and shows you how to use each of the modem's AT commands. These commands and responses are compatible with all systems and with all data communications software using the AT command set.

Modes of Operation

The MT5634HD8/16 operates in two basic functional modes: *command mode* and *online mode*. (There is also an in-between state, *wait-for-carrier*, in which the modem is out of command mode but not yet online.) When you power up the modem, it is in command mode, and is ready to accept and respond to commands from your keyboard or software.

The modem enters online mode after it dials, connects with another modem, and detects a valid carrier signal. If it does not detect a carrier signal within the time frame controlled by register **S7**, the modem abandons the call and re-enters command mode.

You can make the modem enter online mode without dialing by typing either the **D** command or the **A** command.

The modem exits online mode if the carrier signal is lost or intentionally dropped. When this happens, the modem hangs up and re-enters command mode.

By sending certain "escape" characters to the modem while online, you can make it enter command mode without losing the carrier signal.

Command Structure

You can control a wide variety of modem operations and options when the modem is in command mode. AT commands tell the modem to dial a number, to answer a call, to operate at a certain speed, to use a certain compression technique, and many other functions. AT commands consist of one or two letters, which may be preceded by an ampersand (***&***), a percent character (***%***), or a slash character (**). The **Q** command, for example, determines whether the modem returns result codes, while the **&Q**command selects the asynchronous communications mode.

A parameter after a command (0, 1, 2, etc.) tells the modem which option to use. If you do not specify a parameter, the modem assumes the 0 (zero) option. **E**, for example, is the same as **E0**. You can issue several commands on a single line (a command string) as long as the line does not exceed 40 characters.

Note: Each character in a command counts towards the 40 character command line maximum. While **Q1** is a single command, it counts as two characters in the command line.

Each command has a valid range of parameters; for example, **&S** can have only 0 or 1 as a parameter. Valid commands always generate an OK result code, and a few generate an additional response, such as a list of parameters. An invalid command, such as **&S3**, which has a parameter outside the valid range, generates an ERROR result code. Most commands have a default parameter that is enabled when the modem is turned on or reset with the **ATZ** or **AT&F** command. Factory defaults are stored in read-only memory (ROM), and cannot be changed. User-defined defaults can be stored in nonvolatile random-access memory (NVRAM), and can be changed or deleted at will.

Command Editing

Always begin a command with the letters *AT*. Enter the entire command string in upper or lower case, but do not cannot mix cases within the command string. The AT command is not executed until you press the ENTER key. Use the BACKSPACE key to erase the previous command character. It will not erase the AT characters once they are typed. If your keyboard has no BACKSPACE key, use CTRL+H. (You can change the character recognized by the modem as BACKSPACE to any other ASCII character by changing register **S5**.)

Press CTRL+X to cancel an entire command that has been typed but not yet executed. This also clears the command buffer. The effect is the same as backspacing the command, only quicker.

The modem stores characters entered in a command in it's command buffer until they are executed by pressing ENTER. The command buffer's capacity is 40 characters. The attention characters (AT) do not count towards the 40 character command line maximum. You may use spaces for increased readability when typing a command. Spaces are not stored in the command buffer, and they do not count towards the 40 character command line maximum. Special characters, such as hyphens and parentheses, are not allowed.

If you exceed the 40-character limit or type invalid characters, the command buffer is automatically erased and an ERROR message displays. You should retype the command within the 40-character limit, using only the allowed characters.

The commands in this chapter are organized by function. A brief summary follows.

Table 1. AT Commands by Function

Topic	Command	Description	Page
Dialing Action	**D**	Dial	15
	H	On-hook/off-hook	
Dial Modifiers	**L**	Redial last number	16
	P	Pulse dialing	
	T	Tone dialing	
	V	Speakerphone mode	
	W	Wait for new dial tone	
	,	Dialing pause	
	;	Return to command mode after dialing	
	!	Flash on-hook	
	$	Detect call card tone	
	@	Quiet answer	
	^	Disable data calling tone transmission	
Phone Number Memory	**&Z**	Store a phone number	18
	DS	Dial a stored number	
Configuration Storage & Recall	**&W**	Store configuration	18
	&F	Load factory default configuration	
	Z	Reset modem	
	&Y	Select stored configuration on power-up	
Modem Responses (Result Codes)	**E**	Echo command mode characters	19
	Q	Result codes: enable/disable	
	V	Result codes: verbose/terse	
	\V	Protocol result code	
	X	Result codes and call progress	
	&Q	Select asynchronous communications mode	
	%B	View numbers in blacklist	
Online Connection	**B**	Answer tone	22
	C	Carrier control	
	F	Echo online data characters	
	&G	Guard tones	
	-C	Data calling tone	
	N	Modulation handshake	
	\T	Disable inactivity timer	
	Y	Long space disconnect	
RS-232 Interface Controls	**&C**	Carrier Detect control	24
	&D	Data Terminal Ready control	
	&S	Data Set Ready control	
Error Correction & Data Compression	**\N0 or &Q6**	Non-error correction mode	26
	\N3	Auto-reliable mode	
	\N2	Reliable mode	
	%C0	Data compression disabled	
	%C1	Data compression enabled	

Topic	Command	Description	Page
Immediate Action	**A/**	Repeat last command	27
	I	Information request	
	&B	V.32 auto retrain	
	&V	View current configuration	
Flow Control	**&M0**	Asynchronous mode	27
	&K0 or \Q0	Flow control disabled	
	&K3 or \Q3	Hardware flow control	
	&K4 or \Q1	XON/XOFF flow control	
	\X0	XON/XOFF no pass-through	
	&J	Auxiliary relay control	
	\J	Enable data buffer control	
	\G	Modem port flow control	
	\K	Set break control	
	+ES=6	Enable synchronous buffered mode	
Escape Sequences	**+++AT<CR>**	Default in-band escape sequence	29
	A	Force answer mode	
	O	Go back online	
Diagnostics	**&T**	Self-test commands	31
Speaker Settings	**L**	Monitor speaker volume	31
	M	Monitor speaker mode	

Dialing Commands

Dialing commands are used to dial and hang up.

D*s* Dial

s = phone number
Default: none

The letter *D* in a command causes the modem to dial the telephone number immediately following it. For example, if you type **ATD5551212<CR>**, the modem dials the number 555-1212.

The MT5634HD8/16 supports several dialing methods. With the **D** command, you can specify either pulse (**ATDP**) or tone (**ATDT**) dialing. You can also modify the dialing command with several other characters that are explained in the section "Dial Modifier Commands", later in this chapter.

The modem also lets you select either smart (wait-for-dial-tone) dialing or blind dialing. With smart dialing, the modem waits for and detects dial tones and busy signals. With blind dialing, the modem works with timed pauses (determined by the value of register **S6**), not dial tone and busy signal detection. See the **X** command for more information on blind and smart dialing.

H*n* On-Hook/Off-Hook

n = 0 or 1
Default: 0

Use the **H** command to make the modem hang up (go on-hook) or simulate the action of picking up a telephone handset (go off-hook).

H0 (or **H**) hangs up the modem

H1 brings the line off-hook, just as if you had picked up the telephone handset.

It is not necessary to use the **H1** command to bring the line off-hook when using the **D** command. The modem automatically goes off-hook when you press ENTER at the end of the dial command.

Dial Modifier Commands

The dial string can include the digits *0* through *9*, the pound sign (*#*), the asterisk (***), and the letters *A*, *B*, *C*, or *D*. The latter are used by some PBXs; the exact function will depend on the PBX manufacturer's feature set and implementation. There are also several command characters, called "dial modifiers," that can be included within a dialing command after the letter *D*. Their functions include pulse or tone dialing, pauses in the dial sequence, automatic redials if a number is busy, and reverting to command mode or switching to answer mode after dialing.

L Redial Last Number

Default: none

You can redial the last number dialed by entering **L** immediately following the dial command (**ATD**). This command is handy if you encounter a busy signal and want to try the call again.

P, T Pulse or Tone Dialing

Default: **T**

The MT5634HD8/16's modems can dial numbers by using pulse dialing, tone dialing, or a combination of both methods. Pulse dialing, used by rotary-dial telephones, uses the timed opening and closing of a relay to encode the numbers. Tone dialing, used by push-button (touch-tone) telephones, uses dual tone multifrequency (DTMF) dialing.

P selects pulse dialing.

T selects tone dialing.

Insert **P** or **T** in the dialing command just before the digits you want to pulse- or tone-dial. If neither pulse nor tone dialing is specified in the dial command, the modem uses whatever method was used last.

Note: When your modem is first turned on or reset, it uses the tone dialing method, (which is the default), even if you do not include **T** in your dial command.

Examples:
To pulse-dial the number 555-1212, type **ATDP5551212** and press ENTER.

To tone-dial the same number, type **ATDT5551212** and press ENTER.

To call out of a PBX (switchboard) system where a *9* has to be pulse-dialed, and the rest of the number has to be tone-dialed after pausing for a second dial tone, type **ATDP9,T5551212** and press ENTER. (The comma causes a pause.)

V Switch to Speakerphone Mode

Inserting **V** into the dialing command causes the modem to switch to speakerphone mode and dial the following number. Use **ATH** to hang up.

W Wait for New Dial Tone

Inserting **W** into the dialing command causes the modem to wait for another dial tone before it resumes dialing. (It is not necessary to enter **W** at the beginning of the dialing command.)

Note: Because the modem must be able to detect the dial tone for this command to work, you also must select wait-for-dial-tone dialing with the **X2** or **X4** command.

, Dialing Pause

Enter a comma in the dialing string to make the modem pause while dialing. This pause lasts two seconds (North American models) or four seconds (U.K. and International models) for each comma entered. You can force longer pauses by entering multiple commas, or you can change the length of the pause caused by a comma by setting register **S8** to any value from 0 through 255 seconds (North American), 4 through 7 seconds (U.K.) or 4 through 255 seconds (International).

Note: Each comma in a dialing command counts as one of the 40 allowed characters.

; Return to Command Mode After Dialing

Enter a semicolon (**;**) as the last character of a dialing command to cause the modem to return to command mode immediately after executing the command instead of waiting for a carrier signal and going online.

For example, type **ATDT5551212;** to tone-dial the number and immediately go back into command mode. The semicolon is useful when modem data transfer is not desired, as in voice communications, or in applications using touch tones as a data entry method, such as bank-by-phone.

! Flash On-Hook

Some switchboard systems react to a momentary on-hook condition. Insert an exclamation mark into the dialing command to cause the modem to "flash" on-hook for half a second, just as if you had pressed the switch hook on a telephone set for half a second. (With U.K. models, the exclamation mark causes the modem to flash on-hook for 90 milliseconds.)

For example, to flash on-hook to transfer to extension 5678 after dialing the number 555-1234, type **ATDT5551234,,!5678**. The commas cause a 4-second pause.

$ Detect Call Card Tone

Use the **$** command to dial services that require you to enter your call card number after a tone. The **$** character in the dialing string causes the modem to pause and wait for an AT&T call card "bong" or a 1600 Hz tone. When the modem detects the tone, it processes the rest of the dialing string. If it does not detect the tone within the time set in register **S7**, the modem stops processing the dial string with a `NO CARRIER` message. Pressing any key also terminates the **$** command.

@ Quiet Answer

Use the **@** command to access a system that does not provide a dial tone. The **@** command causes the modem to wait before processing the next character in the dialing string. The wait is for one or more rings back followed by five seconds of silence.

For example, **`ATDT5551212@6313550`** causes the modem to dial the first number (555-1212), then wait for the time specified in register **S7** for at least one ringback and five seconds of silence. If the modem detects a busy signal, it hangs up and generates a `BUSY` result code. If it does not detect five seconds of silence, it hangs up and generates a `NO ANSWER` result code. If it does detect five seconds of silence, it dials the second number (631-3550).

^ Disable Data Calling Tone Transmission

Use the **^** command to disable the transmission of data calling tones.

In the following example, the **^** command is used to tone dial 555-1212 and suppress data calling tone transmission.

`ATDT^5551212`

Phone Number Memory Commands

The modem can store up to four telephone numbers in nonvolatile memory. You can store the numbers with the **&Z** command and dial them with the **ATDS** command.

&Z*n*=*s* Store a Phone Number

s = phone number *n*= 0, 1, 2 or 3
Default: none

You can store a telephone number string in the modem's phone number memory. You can store four of these strings using the **&Zn=s** command. The memory locations are labeled *N0* through *N3*.

For example, the telephone number 1-612-555-1212 is stored at memory location N2 by typing **`&Z2=16125551212`** and pressing ENTER.

DS*n* Dial a Stored Number

n = 0, 1, 2, or 3
Default: none

You can automatically dial a telephone number that is stored in the modem's number memory by typing **`ATDSn`**, where *n* = 0 through 3. For example, you can dial a number stored at N2 by typing **`ATDS2`** in terminal mode and pressing ENTER.

Configuration Storage and Recall Commands

The MT5634HD8/16 stores parameters in two places. It stores factory default parameters in read-only memory (ROM), and customized parameters in nonvolatile random access memory (NVRAM). You cannot change the default parameters in ROM, but you can change parameters in temporary memory and then store them in NVRAM as custom settings. You can then recall the custom settings as if they were factory default settings.

&W*n* Store Configuration

n = 0
Default: **&W0**

The **&W** command stores current AT commands and S-register values in nonvolatile memory, so you won't lose your custom settings when you turn off the modem or reset it.

&W0 (or **&W**) stores all current AT command and S-register values in nonvolatile random access memory (NVRAM) and configures the modem so that it reads your custom settings in NVRAM when the modem is turned on or when it is reset with the **Z** command. The **&F** reset command will continue to read the factory default settings in ROM.

&F*n* Load Default Configuration

n = 0
Default: **&F0**

MT5634HD8/16 modems store factory default AT command settings and S-register values in read-only memory (ROM); they store your custom AT command and S-register values in nonvolatile random access memory (NVRAM).

The **&F0** (or **&F**) command resets the modem to the factory default values stored in ROM.

Z*n* Reset Modem

n = 0 or 1
Default: none

The **Z** command resets the modem to the configuration last saved by the **&W** command. The default values come from the customized configuration in NVRAM.

Z1 is the same as **Z0**, and functions identically.

&Y*n* Select Stored Configuration for Hard Reset

n = 0
Default: 0

This command is included for compatibility with applications that issue the **&Y0** command. Modem functions are not changed.

&Y0 selects the profile stored at location 0 on power-up.

Modem Response (Result Code) Commands

The MT5634HD8/16's modems can give responses to commands. The most common one is *OK*, but the modems can also alert you or your software to dial tones, busy signals, connection speeds, and whether the

connection is made with error correction or compression enabled. These responses are called *result codes*, and they can be terse (numbers) or verbose (text).

E*n* Echo Command Mode Characters

n = 0 or 1
Default: **E1**

Normally, when you type commands on the keyboard, the modem echoes the characters back to the computer or terminal, which displays them on the monitor. Use the **E** command to turn this feature off and on.

E0 disables the echo.

E1 enables the echo.

Q*n* Result Codes Enable/Disable

n = 0 or 1
Default: **Q0**

You can use the **Q** command to enable or disable result codes for applications such as computer-controlled auto dialing.

Q0 (or **Q**) enables result codes.

Q1 disables result codes for applications such as computer-controlled auto-dialing.

V*n* Result Codes (Verbose/Terse)

n = 0 or 1
Default: **V1**

The **V** command controls whether the modem's result codes display as text ("verbose") or numeric ("terse") messages. For example, if no carrier signal is detected after dialing, the result can be displayed either as **`NO CARRIER`**, or as the number **`3`**.

V0 (or **V**) displays the modem's result codes as a number.

V1 displays result codes as text.

X*n* Result Codes and Call Progress Selection

n = 0, 1, 2, 3, 4, 5, 6, or 7
Default: **X4**

The **X** command selects which result codes the modem provides in command mode and whether the modem uses "smart dialing" or "blind dialing". When it smart dials, the modem listens for dial tones and busy signals and responds to them. When it blind dials, the modem ignores the signals and relies on timing instead.

X0 causes the modem to blind dial. Instead of looking for a dial tone, it pauses for the time set in register **S6** and then dials regardless. Once a connection has been made, it sends the Bell 103 basic code `CONNECT` to the terminal. It ignores any busy signals.

X1 causes the modem to blind dial, but in addition to the basic `CONNECT` code it provides extended codes consisting of the word `CONNECT` and the speed of the connection (`CONNECT 14400` or `CONNECT 28800`, for example). In this mode, the modem does not recognize or respond to dial tones or busy signals.

X2 causes the modem to wait for a dial tone before dialing. If it does not detect a dial tone within the time set by **S6**, the modem sends a `NO DIALTONE` result code to the terminal. In this mode, the modem provides extended result codes, but does not respond to busy signals.

X3 causes the modem to blind dial, but also it looks for a busy signal, and if it detects one, it sends a `BUSY` result code to the terminal. In this mode, the modem provides extended result codes, but it does not respond to dial tones.

X4 causes the modem to look for a dial tone and a busy signal, and respond with `NO DIALTONE` or `BUSY`, as appropriate. It also provides extended result codes. It is the most useful setting for most data communication programs, and is the default setting.

X5 causes the modem to look for a dial tone and a busy signal, and response with `NO DIALTONE` or `BUSY`, as appropriate. It also provides extended result codes. It is the most useful setting for most data communication programs, and is the default setting.

X6 causes the modem to look for a dial tone and a busy signal, and respond with `NO DIALTONE` or `BUSY`, as appropriate. It also provides extended result codes. It is the most useful setting for most data communication programs, and is the default setting.

X7 causes the modem to wait for a dial tone before dialing. If it does not detect a dial tone within the time set by **S6**, the modem sends only the basic result code to the terminal (`ERROR`, `NO CARRIER`, or `CONNECT`, for example). In this mode, the modem does not respond to busy signals.

&Q*n* Asynchronous Communications Mode

n = 0, 5, or 6
Default: **&Q5**

The **&Qn** command allows you to select the type of asynchronous communications mode for your modem.

Note: These commands are the same as several of the **\N*n*** commands, described later in this chapter.

&Q0 selects asynchronous mode with data buffering. This is the same as **\N0**, non-error correction mode with data buffering.

&Q5 selects error control with data buffering. This is the same as **\N3**, V.42/MNP auto-reliable mode.

&Q6 selects asynchronous mode with data buffering. This is the same as **\N0**, non-error correction mode with data buffering.

%B View Numbers in Blacklist

If blacklisting is in effect, this command displays the numbers for which the last call attempted in the previous two hours failed. In countries that do not require blacklisting, the ERROR result code appears.

Online Connection Commands

The following commands control the conditions of the online connection.

B*n* Answer Tone

n = 0, 1, 2, 3, 15, or 16
Default: **B1** and **B16**

The **B** command selects the frequency the modem uses for its answer tone. (The answer tone is the tone transmitted by the receiving modem to the calling modem, thus initiating the *handshake* between the two modems.) At higher speeds (2400 bps and above) there is no conflict, because all protocols use the Bell frequency of 2225 Hz. Lower speeds require different frequencies.

B0 selects ITU-T V.22 mode when the modem is at 1200 bps.

B1 selects Bell 212A when the modem is at 1200 bps. This is a default.

B2 deselects the V.23 reverse channel.

B3 is identical to **B2** in function. It also deselects the V.23 reverse channel.

B15 selects V.21 when the modem is at 300 bps.

B16 selects Bell 103J when the modem is at 300 bps. This is a default.

C*n* Carrier Control

n = 1
Default: **C1**

The **Cn** command provides backward compatibility with some data communications software.

C1 enables normal transmit carrier switching.

-C*n* Data Calling Tone

n = 0 or 1
Default: **-C0**

The data calling tone is a tone of a certain frequency and cadence, as specified in the V.25 standards, which identifies whether it is remote data, fax, or voice. The frequency is 1300 Hz, with a cadence of .5 s on and 2 s off.

-C0 disables the V.25 data calling tone.

-C1 enables the V.25 data calling tone.

F Echo Online Data Characters

n = 1
Default: **F1**

This command determines if the modem echoes data from the DTE. This command provides backward compatibility with some data communications software.

F1 disables online data character echo.

&G*n* Guard Tones

n = 0, 1, or 2
Default: **&G0** (models outside U.K.) or **&G2** (U.K. models only)

The **&G** command is used to control the presence or absence of guard tones from the transmitter when in answer mode at either 1200 or 2400 bps. Guard tones are used in Europe and other areas to allow the modem to function in the telephone systems. Guard tones are not used in the United States. U.K. models are locked at **&G2** (1800 Hz guard tone).

&G0 disables ITU-T guard tones.

&G1 enables ITU-T 550 Hz guard tone.

&G2 enables ITU-T 1800 Hz guard tone.

N*n* Modulation Handshake

n = 0 or 1
Default: **N1**

This command controls whether or not the local modem performs a negotiated handshake with the remote modem at connection time, when the communication speed of the two modems is different.

N0 enables handshaking only at the communication standard specified by S37 and the **ATB** command.

N1 always begins the handshake only at the communication standard specified by S37 and the **ATB** command, but allows fallback to a lower speed as the handshake proceeds. This is the default.

\T*n* Inactivity Timer

n = 0
Default: **\T0**

The inactivity timer specifies the length of time, in minutes, that the modem will wait before disconnecting when no data is sent or received. This timer is specified in register **S3**. The **\T0** command disables the inactivity timer.

Y*n* Long Space Disconnect

n = 0
Default: **Y0**

When two modems are connected in reliable mode, a link disconnect request packet is sent to request a disconnect. In non-error correction mode, there is no "polite" way to request a disconnect. As a result, some "garbage" may be received when a hang-up command is issued.

Y0 disables the modem's use of the break signal.

RS-232 Interface Commands

These commands define how an MT5634HD8/16 modem will use and respond to standard RS-232 signals.

&C*n* Carrier Detect Control

n = 0 or 1
Default: **&C1**

The **&C** command lets you control the Carrier Detect (CD) signal on the RS-232/V.24 interface. This is a signal from the modem to your computer indicating that the carrier signal is being received from a remote modem. Normally, CD goes "high" (turns on) when the modem detects a carrier on the communications link, and "drops" (turns off) when it loses the carrier. By using **&C**, you can force the signal to stay high, or to drop momentarily when the remote modem disconnects. This option is useful with some CBX phone systems and mainframe front ends, which require CD to act in this manner.)

&C0 ignores the state of the carrier from the remote modem. CD is forced high.

&C1 allows CD to act normally—to go high when the modem detects a carrier, and to drop when it loses the carrier.

&D*n* Data Terminal Ready Control

n = 0, 1, 2, or 3
Default: **&D2**

The Data Terminal Ready (DTR) signal on pin 20 of the RS-232/V.24 interface must be high, or "on," in order for the modem to operate. A high DTR signal tells the modem that the computer it is connected to is ready to communicate through the modem.

The DTR signal can also be used to cause the modem to reset to its default parameters, as if you had given the modem an ATZ command.

&D0 (or **&D**) causes the modem to ignore the DTR signal and treat it as always on.

&D1 causes the modem, if in online data mode, to enter command mode, issue an OK and remain connected when the DTR drops.

&D2 causes the modem to hang up when DTR drops while the modem is in online data mode.

&D3 causes the modem to reset when DTR drops . It will also hang up if it is online.

&S*n* Data Set Ready Control

n = 0 or 1
Default: **&S0**

Use the **&S** command to control the state of the Data Set Ready (DSR) signal on the RS-232/V.24 interface. Normally, DSR follows CD. You can force the signal high or allow it to act normally.

&S0 forces DSR high (on).

&S1 allows DSR to act normally, that is, to follow CD.

Error Correction and Data Compression Commands

You can configure a modem to any of three different V.42 modes of operation (each mode can be with or without compression). They are the non-error correction, auto-reliable, and reliable modes. You can also turn data compression on or off.

\N*n* Error Correction Modes

n = 0, 1, 2, 3, 4, 5, or 7
Default: **\N3**

Select the modem's error correction mode using the **\N** command.

\N0 disables the modem's V.42 error correction capabilities, and the modem functions as a non-error correction modem, with data buffering. This is the same as **&Q6**, described earlier in this chapter.

\N1 causes the modem to function in direct mode.

\N2 enables reliable mode, in which the modem uses its V.42 error correction capabilities for all transmissions. In reliable mode, the modem must be connected to a modem with the V.42 MNP protocol.

\N3 enables auto-reliable mode. During the handshaking procedures at the start of the online connection, the modem queries whether the other modem is using V.42 error correction. If the modem determines that the other modem is using V.42, it switches itself into reliable (V.42) mode and enables error correction. If it determines that the other modem is not using V.42, the modem remains in non-error correction mode. (This is the same as **\N5** and **\N7**.)

\N4 enables reliable mode, in which the modem uses its V.42 error correction capabilities for all transmissions. In reliable mode, the modem must be connected to a modem with a V.42 protocol (MNP or LAP-M).

The V.42 standard includes MNP Class 3 and 4 and LAP-M error correction methods.

\N5 enables auto-reliable mode. During the handshaking procedures at the start of the online connection, the modem queries whether the other modem is using V.42 error correction. If the modem determines that the other modem is using V.42, it switches itself into reliable (V.42) mode and enables error correction. If it determines that the other modem is not using V.42, the modem remains in non-error correction mode. (This is the same as **\N3** and **\N7**.)

\N7 enables auto-reliable mode. During the handshaking procedures at the start of the online connection, the modem queries whether the other modem is using V.42 error correction. If the modem determines that the other modem is using V.42, it switches itself into reliable (V.42) mode and enables error correction. If it determines that the other modem is not using V.42, the modem remains in non-error correction mode. (This is the same as **\N3** and **\N5**.)

%C*n* Data Compression

n = 0 or 1
Default: **%C1**

The **%C** command allows you to disable data compression. Data compression is normally enabled.

%C0 disables V.42bis/MNP 5 data compression.

%C1 enables V.42bis/MNP 5 data compression.

Immediate Action Commands

Use these commands to get information about AT commands and the current settings of the modem.

A/ Repeat Last Command

Default: None

Type **A/** to repeat the previous command. Do not precede this command with **AT** or press ENTER to execute it.

I*n* Information Request

n = 0, 1, 2, 3, 4, or 9
Default: none

This command displays specific product information about your modem.

I0 or **I** returns the default speed and controller firmware version number. Use this command to identify your modem's firmware level before calling Multi-Tech Technical Support. (This is the same as **I3**.)

I1 calculates and displays the ROM checksum (for example, *12AB*).

I2 performs a ROM check, calculates and verifies the ROM checksum, and displays the results (*OK* or *ERROR*).

I3 returns the default speed and controller firmware version number. Use this command to identify your modem's firmware level before calling Multi-Tech Technical Support. (This is the same as **I or I0**.)

I4 returns the firmware version for the data pump (for example, *94*).

I9 displays the country code (for example, *NA Ver. 1*).

&B*n* V.32 Auto Retrain

n = 1
Default: **&B1**

The **&B1** command enables V.32 auto retrain.

&V View Current Configuration

Default: none

Use the **&V** command to display the active modem settings.

Flow Control Commands

Flow control refers to the techniques used by data terminal equipment and the MT5634HD8/16 to pause and resume the flow of information between them. It prevents a device from accepting more data than it can handle. The MT5634HD8/16 implements flow control in both directions.

When the MT5634HD8/16 halts the flow of data, it is called flow control, and when the computer halts the flow, it is called pacing.

&M*n* Communications Mode

n = 0
Default: **&M0**

The **&M** command enables asynchronous communications mode. This is the default.

&K*n* Local Flow Control Selection

n = 0, 3, or 4
Default: **&K3**

The **&K** command allows you disable flow control, and enable hardware or software flow control.

&K0 completely disables data flow control initiated by the modem. (This is the same as **\Q0**.)

&K3 enables the modem's use of the Clear to Send (CTS) signal on the RS-232/V.24 interface to regulate data flow. When CTS drops, data flow is suspended until the signal goes "high" (on) again. This method of flow control works in conjunction with pacing (i.e., computer-initiated flow control), which uses the Request to Send (RTS) signal on the RS-232/V.24 interface. Hardware flow control cannot be enabled unless an active error correction protocol is selected. This is the factory default setting. (This is the same as **\Q3**.)

&K4 enables XON/XOFF software flow control. XON/XOFF flow control is an in-band method of data flow regulation. In-band data regulation means that the XON (^Q) and XOFF (^S) characters are inserted into the stream of data rather than using separate control lines. When an XOFF character is detected, the data stream is suspended until an XON character is detected. If you issue the **&K4** command to the modem, it will respond to XON/XOFF pacing, and use XON/XOFF characters as its own method of flow control to the computer. (This is the same as **\Q1**.)

The drawback to using this method of pacing is that some files may contain these characters as part of the file data. If such a file is transferred using a modem with XON/XOFF flow control enabled, the file transfer could fail due to indefinite suspension.

\Q*n* Local Flow Control Selection

n = 0, 1, or 3
Default: **\Q3**

The **\Q** command allows you disable flow control, and enable hardware or software flow control.

\Q0 completely disables data flow control initiated by the modem. (This is the same as **&K0**.)

\Q1 enables XON/XOFF software flow control. XON/XOFF flow control is an in-band method of data flow regulation. In-band data regulation means that the XON (^Q) and XOFF (^S) characters are inserted into the stream of data rather than using separate control lines. When an XOFF character is detected, the data stream is suspended until an XON character is detected. If you issue the **&K4** command to the modem, it will respond to XON/XOFF pacing, and use XON/XOFF characters as its own method of flow control to the computer. (This is the same as **&K4**.)

The drawback to using this method of pacing is that some files may contain these characters as part of the file data. If such a file is transferred using a modem with XON/XOFF flow control enabled, the file transfer could fail due to indefinite suspension.

\Q3 enables the modem's use of the Clear to Send (CTS) signal on the RS-232/V.24 interface to regulate data flow. When CTS drops, data flow is suspended until the signal goes "high" (on) again. This method of flow control works in conjunction with pacing (i.e., computer-initiated flow control), which uses the Request to Send (RTS) signal on the RS-232/V.24 interface. Hardware flow control cannot be enabled unless an active error correction protocol is selected. This is the factory default setting. (This is the same as **&K3**.)

\X*n* XON/XOFF Pass-Through

n = 0
Default: **\X0**

When XON/XOFF pacing is active, the local modem has two options regarding the XON and XOFF characters. It can respond to and discard the characters from the computer, or it can respond to the characters and pass them through the data communications link to the remote modem, thereby pacing the remote modem as well.

&X0 causes the modem to respond to and discard the XON and XOFF characters. This is the default.

&J*n* Auxiliary Relay Control

n = 0
Default: **&J0**

The **&J0** command causes the auxiliary relay to remain open. It is never closed. This is the default, and the only supported command format.

\G*n* Modem Port Flow Control

n = 0
Default: **\G0**

This command returns an *OK* for backward compatibility with some software.

\J*n* Data Buffer Control

n = 0
Default: **\J0**

This command enables data buffer control. Serial port speed is independent of connect speed.

\J0 enables data buffer control. This is the default, and the only supported command format.

\K*n* Set Break Control

n = 5
Default: **\K5**

This command determines how the modem processes a break signal received from the local DTE during an online connection.

\K5 causes the modem to send the break to the remote modem in sequence with transmitted data, non-destructive, non-expedited.

+ES=6 Enable Synchronous Buffered Mode

Default: none

This command allows an H.324 video application direct access to the synchronous data channel. On underflow, the modem sends HDLC flag idle (0x7E) to the remote modem. This special error correction mode is overridden by any of the following commands: **&F**, **&M**, **&Q**, and **\N**. **+ES=?** shows the only allowed value.

Escape Sequences

Escape sequences are also known as escape codes. They are used to cause the modem to enter command mode from online mode without disconnecting the call.

+++AT<CR> In-Band Escape Sequence

If the modem is online with a remote modem, you can cause the modem to enter command mode without disconnecting the call by typing an escape code. The default escape code used by the modem is three plus signs (*+++*) followed by the letters *AT*, up to 10 command characters (most typically *H*, to hang up), and ENTER. The modem then escapes to command mode, executes the command (if any), and remains in command mode. For example, to hang up the modem at the end of a call, type **+++ATH <CR>**.

A Force Answer Mode

You can use the **A** command to force the modem into answer mode. Type **ATA** when in command mode to immediately bring your modem off-hook, out of command mode, into online answer mode, and to cause it to transmit its carrier signal over the phone line. If no responding carrier tone is received by your modem within forty-five seconds (or by the time you have specified in register **S7**), your modem stops transmitting its tone, hangs up, and goes back into command mode.

O*n* Go Back Online

n = 0, 1, or 3
Default: none

You can use the **O** command to bring the modem out of command mode and back into online mode. The **O** command reverses the result of entering the escape code. The **O** command brings the modem into whichever online mode (originate or answer) that it was in prior to entering command mode.

O0 causes the modem to exit command mode and return to online data mode.

O1 causes the modem to issue a retrain before returning to online data mode.

O3 causes the modem to issue a rate renegotiation before returning to online data mode.

Diagnostic Commands

Diagnostic commands help you troubleshoot your modem when problems occur.

&T*n* Self-Test Commands

n = 0, 1, 3, or 6
Default: none

The **&T** command causes the modem to perform various self-tests.

&T0 causes the modem to stop any test currently in progress.

&T1 causes the modem to perform a local analog loop test, which verifies modem operation and the connection between the modem and the computer. Any data entered at the local DTE is modulated, then demodulated, and returned to the local DTE. To function properly, the modem must be off-line.

&T3 causes the modem to perform a local digital loopback test.

&T6 causes the modem to perform a remote digital loopback test, which verifies the integrity of the local modem, the communications link, and the remote modem. Any data entered at the local DTE is sent to, and returned from, the remote modem. To function properly, the modems must be online with error correction disabled.

Speaker Settings

These commands allow you to adjust your modem speaker settings.

L*n* Monitor Speaker Volume

n = 0, 1, 2, or 3
Default: **L2**

The **L** command allows you to adjust your modem speaker volume.

L0 causes the modem to use low volume. This is the same as **L1**.

L1 causes the modem to use low volume. This is the same as **L0**.

L2 causes the modem to use medium volume. This is the default.

L3 causes the modem to use high volume.

M*n* Monitor Speaker Mode

n = 0, 1, 2, or 3
Default: **M1**

The **M** command allows you to control the modem speaker mode.

M0 completely disables the speaker.

M1 causes the speaker to be on only until a carrier signal is detected. This is the default. It allows you to hear the initial dial tones and handshake "squawking" when dialing out, for example, which lets you know activity is taking place and when a carrier signal has been detected (the "squawking" stops).

M2 causes the speaker to remain whenever the modem is off-hook.

M3 causes the speaker to remain on until the carrier is detected, except while dialing. This means the speaker is on during the dialing, so you hear the dialing tones, but turns off during the handshake, so you eliminate the "squawking".

4 S-Registers

Introduction

This chapter describes the MT5634HD8/16's *S-registers*, which are small regions of memory where modem configuration information is stored. Whereas AT commands tell a modem *what* to do, S-registers tell the modem *how* to do it. Each S-register has a name that consists of the letter *S* and a number (**S0**, **S1**, **S2**, etc.), hence the term *S-register*. Use the **S*r*?** command to read the value stored in an S-register, and the **S*r*=*n*** command to change it.

S-Registers

S0 Number of Rings Until Modem Answers

Unit: 1 ring
Range: 0–255
Default: 0

S0 defines the number of rings the modem waits before answering an incoming call. The default value is zero (0), which effectively disables the auto-answer function. When auto-answer is disabled, the modem can only answer via the **ATA** command. Set the **S0** register value to one (1) to causes the modem to answer the call immediately after the first ring. The maximum number of rings that can be configured is 255.

S1 Ring Count

Unit: 1 ring
Range: 0–255
Default: 0

S1 counts the number of rings that have occurred. It is a "read" type of register and is seldom, if ever, used in typical operation. Each time an incoming ring signal is detected, **S1** increases its value by one, up to a maximum of 255. If you set **S1** to a value other than its default value of zero, or if the value is increasing with rings, this new value remains stored in **S1** for eight seconds after the last ring is counted, after which the value reverts back to zero.

S2 Escape Code Character

Unit: Decimal
Range: 0–255
Default: 43 (+)

S2 defines the escape code character by its decimal ASCII code. The default character is the plus (+) sign (decimal 43). **S2** may be set for any ASCII character. Setting an **S2** value greater than 127 results in no escape character, and therefore no means of entering command mode from online mode without breaking the online connection, unless you use the BREAK method.

Note: If you change the **S2** value, you must make corresponding changes in your data communications software.

S3 Return Character

Unit: Decimal
Range: 0–127
Default: 13 (^M)

S3 defines the carriage return character by its decimal ASCII code. The default setting is the ^M character (decimal 13), which is the code for the ENTER key on most keyboards. **S3** may be set for any ASCII character.

Note: If you change the **S3** value, you must make corresponding changes in your data communications software.

S4 Line Feed Character

Unit: Decimal
Range: 0–127
Default: 10 (^J)

S4 defines the line feed character by its decimal ASCII code. The default setting is ^J (decimal 10), which is the code for the line feed key on most keyboards that have such a key. **S4** may be set for any ASCII character.

S5 Backspace Character

Unit: Decimal
Range: 0–127
Default: 8 (^H)

S5 defines the backspace character by its decimal ASCII code. The default setting is the ^H character (decimal 8), which is the code for the BACKSPACE key on most keyboards. **S5** may be set for any ASCII character. Setting S2 to a value greater than 32 disables the backspace character.

Note: If you change the **S5** value, you must make corresponding changes in your data communications software.

S6 Wait Time for Dial Tone

Unit: 1 second
Range: 2–65 (North America), 4–255 (International), 4–7 (U.K.)
Default: 2 (North America), 4 (International and U.K.)

S6 defines the length of time the modem waits after the ENTER key is pressed before executing a dial command. The default setting is two seconds for North America, four seconds elsewhere.

S7 Time to Wait for Carrier

Unit: 1 second
Range: 1–255 (USA), 1–45 (Canada and International), or 1–55 (U.K.)
Default: 50 (North America and International) or 55 (U.K.)

S7 determines the amount of time your modem will wait for a carrier signal before it disconnects. The default value is 50 seconds, except the U.K. model, which defaults to 55 seconds. This means that, after dialing, the modem waits for a carrier signal for up to 50 or 55 seconds and, if none is detected, terminates the call. The maximum **S7** value is 255 seconds for the USA model, 45 seconds for Canadian and International models, and 55 seconds for the U.K. model. **S7** also determine the wait for silence time for the **@** dial modifier.

S8 Pause Time for Comma

Unit: 1 second
Range: 0–65 (North America), 4–255 (International), 4–7 (U.K.)
Default: 2 (North America), 4 (International and U.K.)

S8 determines the length of the pause caused by a comma character in a dialing command. The default setting is two seconds for the North American model, and four seconds for the International and U.K. models. **S8** may be set for up to 65 seconds. **S8** also defines the length of time the modem waits before retrying a call after it detects a busy signal. Some computer systems need more than two seconds to reset, in which case you should increase the value of **S8**.

S10 Carrier Loss Disconnect Delay Time

Unit: 100 ms
Range: 1–254
Default: 20

S10 defines the length of time, in milliseconds, that the modem waits after a loss of carrier signal before the it disconnects. The default setting is 2000 ms (20 units of 100 ms each). Maximum delay is 25400 milliseconds, or 25.4 seconds (decimal 254).

S11 Tone Dialing Spacing and Duration

Unit: 1 ms
Range: 50 - 150 (USA) or 80–255 (Canada, U.K., International)
Default: 95 (USA) or 80 (Canada, U.K., International)

S11 sets the speed of tone dialing (spacing and tone duration times). The default value is 95 units for domestic models and 80 units for Canadian and International models, where each unit is one ms. In other words, for domestic modems, each tone is sustained for 95 ms followed by a 95 ms pause. The minimum **S11** value allowed is 50 ms (50 units). The maximum S11 value is 150 ms (150 units).

S28 Enable / Disable V.34 Modulation

Unit: decimal
Range: 0, 1–255
Default:1 (enabled)

S28 enables or disables V.34 modulation. Setting **S28** to zero (0) disables V.34 modulation. Any other setting (1-255) enables V.34 modulation.

S35 Data Calling Tone

Unit: decimal
Range: 0–1
Default: 0 (disabled)

S35 enables or disables the V.25 data calling tone, which allows remote data, fax and voice discrimination. Setting **S35** to zero (0) disables V.25 data calling tone; setting **S35** to 1 enables data calling tone. The default setting is 1.

S37 Maximum Dial Line Rate

Unit: decimal
Range: 0–19
Default: 0

S37 sets the maximum dial line rate. When set to zero (0), the maximum dial line rate is the same as the maximum modem speed. This is the most common setting, and allows other modem functions to actually determine the line rate used for each connection. It is the default. Consider using **S37** to set a maximum dial line rate if you need to artificially retain a lower modem speed.

0 = maximum modem speed	13 = 19200 bps
1 = reserved	14 = 21600 bps
2 = 1200/75 bps	15 = 2400 bps
3 = 300 bps	16 = 26400 bps
4 = reserved	17 = 28800 bps
5 = 1200 bps	18 = 31200 bps
6 = 2400 bps	19 = 33600 bps
7 = 4800 bps	20 =
8 = 7200 bps	21 =
9 = 9600 bps	22 = 45000 bps
10 = 12000 bps	23 =
11 = 14400 bps	24 =
12 = 16800 bps	25 = 56000 bps

S42 Enable / Disable V.32bis and V.22bis Auto Rate

Unit: decimal
Range: 0-1
Default: 1 (enabled)

This register is used for testing and debugging only.

S42 enables and disables the V.32bis and V.22bis auto rate. Retrain and fallback are disabled in data mode. Set **S42** to zero (0) to disable auto rate, or 1 (the default) to enable auto rate.

S43 Enable / Disable V.32bis Start-up Auto Mode

Unit: decimal
Range: 0-1
Default: 1 (enabled)

This register is used for testing and debugging only.

S43 enables and disables V.32bis start-up auto mode operation. Set **S43** to zero (0) to disable start-up auto mode, or 1 (the default) to enable start-up auto mode.

S89 Off-line Time

Unit: 1 second
Range: 0, 5-255
Default: 10

S89 sets the length of time, in seconds, a modem waits in the off-line command mode before it goes into standby mode. If **S89** is set to 20 seconds, the modem waits 20 seconds in off-line command mode before going into standby mode. Setting **S89** to zero (0) prevents the modem from ever entering standby mode.

Setting **S89** to any value between zero and five (1-4) effectively sets the value to five, because five seconds is the minimum possible wait time.

Reading and Assigning S-Register Values

Use the **S** command to assign a value to an S-register and to read an S-register's current value.

To read an S-register value, in terminal mode, type **S,** the S-register number, and a question mark (**?**), and press ENTER. For example, to display the value of register **S7**, type **ATS7?** and press ENTER. The answer will appear as a three-digit decimal number (e.g., *045*).

To assign a new value to an S-register, type **S,** the S-register number, an equals sign (=), and a decimal number. Convert all ASCII characters to their decimal equivalents before entering them. Valid S-register decimal values are shown for each register in the previous section. To make the change permanent, use the **&W0** command.

Examples of Assigning Values

1. You want to have longer pauses caused by the comma in a dial command: five seconds instead of two. Type **ATS8=5** to assign 5 as the value for register **S8**. The modem will now pause five seconds for every comma in a dial command.
2. You want to configure your modem to answer incoming calls after the fourth ring instead of after the first ring. To configure register **S0** with a value of 4, type **ATS0=4** and press ENTER.
3. You are calling long distance to another country code, and it is taking a long time to connect. The register **S7** (time to wait for carrier) factory default setting of 50 seconds is insufficient; a time-out occurs and cancels the call before a connection is made. To change the **S7** value to 75 seconds, type **ATS7=75** and press ENTER. Now, after dialing, the modem allows 25 more seconds for a carrier signal before aborting the call. The additional 25 seconds should provide enough time for international calls.

Examples of Reading Values

1. To verify that you entered the value correctly in the preceding examples, type **ATS8?** and press ENTER in the first example, **ATS0?** in the second example, and **ATS2?** in the third example. You should receive the responses *005*, *004*, and *075*, respectively.
2. When configuring S-registers, it is a good practice to include the verification read command in the same command string as the configuration assignment command. In the three preceding examples, type **ATS8=5S8?**, **ATS0=4S3?**, and **ATS7=75S7?,** respectively.

AT Commands that Affect S-Registers

For maximum throughput, the MT5634HD8/16's default configuration is for originating a call to another 33,600 bps modem that supports error correction, data compression, and flow control. If the receiving modem is not compatible, the MT5634HD8/16 can match any ITU-T or Bell standard modem (but not proprietary protocols).

If you require a different configuration for your application, for example, if you want to use an MT5634HD8/16 modem strictly as an auto answering device, or for service that does not support error correction, you can selectively change the command parameters and S-register values in active memory and save the new values by using the **&W** command.

The **&W0** (or **&W**) command stores all current AT command and S-register values into nonvolatile random access memory (NVRAM) and configures the modem so that it reads your custom settings in NVRAM when the modem is turned on or when it is reset with the Z command. (The **&F** reset command will continue to read the factory default settings in read-only memory [ROM].) For convenience, you can include the **&W** command in the same command string that sets the new values in active memory, as in the following example:

```
AT\N2&C1S0=10&W0<CR>
```

Appendices

Appendix A ASCII Conversion Chart

CTRL	CODE	HEX	DEC	CODE	HEX	DEC	CODE	HEX	DEC	CODE	HEX	DEC
@	NUL	00	0	SP	20	32	@	40	64	`	60	96
A	SOH	01	1	!	21	33	A	41	65	a	61	97
B	STX	02	2	"	22	34	B	42	66	b	62	98
C	ETX	03	3	#	23	35	C	43	67	c	63	99
D	EOT	04	4	$	24	36	D	44	68	d	64	100
E	ENQ	05	5	%	25	37	E	45	69	e	65	101
F	ACK	06	6	&	26	38	F	46	70	f	66	102
G	BEL	07	7	'	27	39	G	47	71	g	67	103
H	BS	08	8	(	28	40	H	48	72	h	68	104
I	HT	09	9	)	29	41	I	49	73	i	69	105
J	LF	0A	10	*	2A	42	J	4A	74	j	6A	106
K	VT	0B	11	+	2B	43	K	4B	75	k	6B	107
L	FF	0C	12	,	2C	44	L	4C	76	l	6C	108
M	CR	0D	13	-	2D	45	M	4D	77	m	6D	109
N	SO	0E	14	.	2E	46	N	4E	78	n	6E	110
O	SI	0F	15	/	2F	47	O	4F	79	o	6F	111
P	DLE	10	16	0	30	48	P	50	80	p	70	112
Q	DC1	11	17	1	31	49	Q	51	81	q	71	113
R	DC2	12	18	2	32	50	R	52	82	r	72	114
S	DC3	13	19	3	33	51	S	53	83	s	73	115
T	DC4	14	20	4	34	52	T	54	84	t	74	116
U	NAK	15	21	5	35	53	U	55	85	u	75	117
V	SYN	16	22	6	36	54	V	56	86	v	76	118
W	ETB	17	23	7	37	55	W	57	87	w	77	119
X	CAN	18	24	8	38	56	X	58	88	x	78	120
Y	EM	19	25	9	39	57	Y	59	89	y	79	121
Z	SUB	1A	26	:	3A	58	Z	5A	90	z	7A	122
[	ESC	1B	27	;	3B	59	[	5B	91	{	7B	123
\	FS	1C	28	<	3C	60	\	5C	92	|	7C	124
]	GS	1D	29	=	3D	61	]	5D	93	}	7D	125
^	RS	1E	30	>	3E	62	^	5E	94	~	7E	126
_	US	1F	31	?	3F	63	_	5F	95	DEL	7F	127

NUL	Null, or all zeros	VT	Vertical Tab	SYN	Sync.
SOH	Start of Header	FF	Form Feed	ETB	End Transmission Block
STX	Start of Text	CR	Carriage Return	CAN	Cancel
ETX	End of Text	SO	Shift Out	EM	End of Medium
EOT	End of Transmission	SI	Shift In	SUB	Substitute
ENQ	Enquiry	DLE	Data Link Escape	ESC	Escape
ACK	Acknowledge	DC1	Device Control 1	FS	File Separator
BEL	Bell or Alarm	DC2	Device Control 2	GS	Group Separator
BS	Backspace	DC3	Device Control 3	RS	Record Separator
HT	Horizontal Tab	DC4	Device Control 4	US	Unit Separator
LF	Line Feed	NAK	Negative Acknowledge	DEL	Delete

Appendix B Dial Pulses and Tones

Dial Pulses

When you pulse dial, as when you make a call with a rotary dial telephone, your telephone or modem generates codes in the form of pulses that simulate the opening and closing of old-fashioned electric relays, or switches. The number of pulses in a code are the same as the digit they encode; thus, the digit *1* is represented by one pulse, the digit *2* by two pulses, etc. In Figure B-1, the digit *2* is pulse dialed, followed by the digit *1*. Each pulse consists of an A ms open (break) and a B ms closed (make), where A is either 60 or 67 ms, and B is either 40 or 33 ms, for a total of 100 ms per cycle, or a rate of 10 pulses per second. The interdigital pause time is 800 ms. The pulse ratios are controlled by the **&P** command.

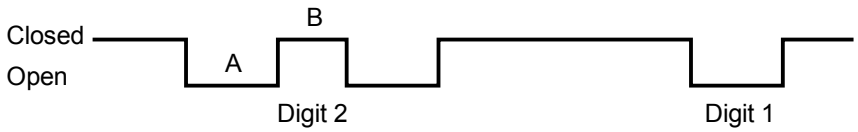

Figure 2. Dial pulses

Tone Dial Frequencies

The tone dialing method combines two frequencies for each of the twelve digits found on a touch-tone dial pad. This method is referred to as dual-tone multi-frequency (DTMF) dialing.

The four horizontal rows on a touch-tone keypad use four low-frequency tones (697, 770, 852, 941 Hz), while the three vertical columns use three high-frequency tones (1209, 1336, 1477 Hz). The tone frequency tolerance is ± 0.02%.

For example, the digit 4 is dialed by combining two tone frequencies: 770 Hz from the second row, and 1209 Hz from the first column. In another example, the digit 9 is dialed with tone frequencies 852 Hz and 1477 Hz.

Hz		Digits	
697	1	2	3
770	4	5	6
852	7	8	9
941	*	0	#
Hz	1209	1336	1477

Figure 3. Standard DTMF frequencies

The extended DTMF characters (A, B, C, D) are the high-end frequencies (1633 Hz) defined on some telephone sets with a fourth vertical column of buttons. This fourth column provides for extended PBX control functions. The actual functions that are provided depend on the PBX manufacturer's implementation and feature set.

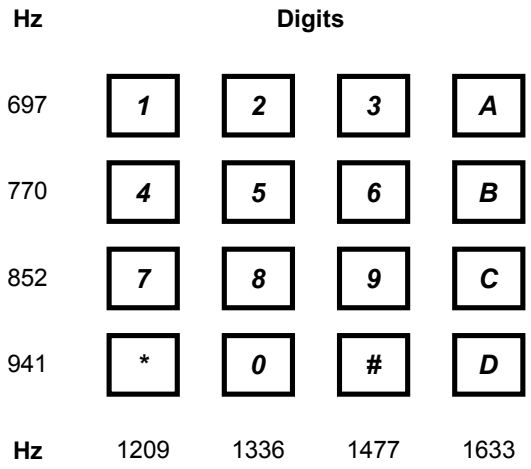

Figure 4. Extended DTMF frequencies

Appendix C Result Code Summary

Multi-Tech Result Codes

Terse	Verbose	Definition
0	OK	Command was executed without error; ready for next command.
1	CONNECT	Modem has detected carrier and gone online.
2	RING	Modem has detected ring caused by incoming call.
3	NO CARRIER	No carrier signal has been detected within the allowed time.
4	ERROR	Error in command line (too many, or invalid characters).
5	CONNECT 1200	Modem has detected carrier at 1200 bps and gone online.
6	NO DIALTONE	No dial tone has been detected.
7	BUSY	A busy signal has been detected.
8	NO ANSWER	The remote system did not answer.
10	CONNECT 2400	Modem has detected carrier at 2400 bps and gone online.
11	CONNECT 4800	Modem has detected carrier at 4800 bps and gone online.
12	CONNECT 9600	Modem has detected carrier at 9600 bps and gone online.
13	CONNECT 14400	Modem has detected carrier at 14400 bps and gone online.
14	CONNECT 19200	Modem has detected carrier at 19200 bps and gone online.
24	CONNECT 7200	Modem has detected carrier at 7200 bps and gone online.
25	CONNECT 12000	Modem has detected carrier at 12000 bps and gone online.
86	CONNECT 16800	Modem has detected carrier at 16800 bps and gone online.
40	CONNECT 300	Modem has detected carrier at 300 bps and gone online.
55	CONNECT 21600	Modem has detected carrier at 21600 bps and gone online.
56	CONNECT 24000	Modem has detected carrier at 24000 bps and gone online.
57	CONNECT 26400	Modem has detected carrier at 26400 bps and gone online.
58	CONNECT 28800	Modem has detected carrier at 28800 bps and gone online.
59	CONNECT 31200	Modem has detected carrier at 31200 bps and gone online.
60	CONNECT 33600	Modem has detected carrier at 33600 bps and gone online.
	CONNECT 45000	Modem has detected carrier at 45000 bps and gone online.
	CONNECT 56000	Modem has detected carrier at 56000 bps and gone online.
88	DELAYED	Delay is in effect for the dialed number.
89	BLACKLISTED	The dialed number is blacklisted.
90	BLACKLIST FULL	The blacklist is full.

Extended Result Codes. If the extended result codes configuration option is enabled, **EC** is added to the following result codes:

```
 5   CONNECT 1200
10   CONNECT 2400
11   CONNECT 4800
12   CONNECT 9600
13   CONNECT 14400
14   CONNECT 19200
24   CONNECT 7200
25   CONNECT 12000
86   CONNECT 16800
40   CONNECT 300
55   CONNECT 21600
56   CONNECT 24000
57   CONNECT 26400
58   CONNECT 28800
59   CONNECT 31200
60   CONNECT 33600
     CONNECT 45000
     CONNECT 56000
```

EC is replaced by one of the following codes, depending on the type of error control connection:

Code	Error Correction
V42bis	LAP-M V.42 error control and V.42bis data compression
V42	LAP-M V.42 error control only
MNP5	MNP4 error control and MNP 5 data compression
MNP4	MNP 4 error control only
NoEC	No error control protocol

Appendix D S-Register Summary

Register	Unit	Range	Default	Description
S0	1 ring	0, 1–255	0	Sets the number of rings before the modem answers. **ATS0=0** disables auto answer completely.
S1	1 ring	0–255	0	Counts the rings that have occurred.
S2	decimal	0–255	43 (+)	Sets ASCII code for the escape code character. Values greater than 1227 disable the escape sequence.
S3	decimal	0–127	13 (^M)	Sets ASCII code for the RETURN character.
S4	decimal	0–127	10 (^J)	Sets ASCII code for the LINE FEED character.
S5	decimal	0–127	8 (^H)	Sets ASCII code for the BACKSPACE character Values greater than 32 disable the backspace character.
S6	1 sec	2–65 4–255† 4–7‡	2 4† 4‡	Sets the time the modem will wait for a dial tone before cancels the call.
S7	1 sec	1–255 1–45* 1–55‡	50 45* 55‡	Sets the time the modem will wait for a carrier signal before aborting a call. Also sets the wait for silence time for the **@** dial modifier.
S8	1 sec	0–65 4–255† 4–7‡	2 4† 4‡	Sets the length of the pause caused by a comma character in a dialing command.
S10	100 ms	1–254	20	Sets how long a carrier signal must be lost before the modem disconnects.
S11	1 ms	50–150 80–255* 80–255‡	95 80* 80‡	Sets spacing and duration of dialing tones. 50 ms is the minimum allowed.
S28	decimal	0, 1–255	1	0 disables, 1–255 enables V.34 modulation.
S35	decimal	0–1	0	0 disables, 1 enables the V.25 data calling tone, which allows data/fax/voice discrimination.
S37	decimal	01–19	0	Sets the maximum dial line rate. 0 = maximum speed 1 = reserved 2 = 1200/75 bps 3 = 300 bps 4 = reserved 5 = 1200 bps 6 = 24-- bps 7 = 4800 bps 8 = 7200 bps 9 = 9600 bps 10 = 12000 bps 11 = 14400 bps 12 = 168000 bps 13 = 19200 bps 14 = 21600 bps 15 = 24000 bps 16 = 26400 bps 17 = 28800 bps 18 = 31200 bps 19 = 33600 bps

Register	Unit	Range	Default	Description
S42	decimal	0–1	10	*For testing and debugging only.* Enables / disables V.32bis and V.22bis auto rate. Retrain and fallback are disabled in data mode. 0 = disable; 1 = enable..
S43	decimal	0–1	1	*For testing and debugging only.* Enables / disables V.32bis start-up auto mode operation. 0 = disable, 1 = enable.
S89	1 sec	0, 5-255	10	Sets the length of time in the off-line command mode before the modem goes into standby mode. A value of zero prevents standby mode; a value of 1-4 sets the value to 5.

* Values for International and Canadian modems only.

† Values for International modems only.

‡ Values for UK modems only.

Appendix E AT Command Summary

Command	Values		Description
AT	n/a		**Attention Code** The attention code precedes all command lines except **A/** and the escape sequence.
RETURN or **ENTER**	n/a		**RETURN Key** Press the RETURN (ENTER) key to execute most commands.
A	n/a		**Force Answer Mode** Answer call immediately without waiting for ring.
A/	n/a		**Repeat Last Command** Repeat the last command string. Do *not* precede this command with AT. Do *not* press RETURN (or ENTER) to execute.
B*n*	*n* = 0, 1, 2, 3, 15, or 16		**Answer Tone**
		***	B0 Select ITU-T V.22 mode when modem is at 1200 bps.
		***	B1 Select Bell 212A when modem is at 1200 bps.
			B2 Deselect V.23 reverse channel.
			B3 Deselect V.23 reverse channel.
			B15 Select V.21 when the modem is at 300 bps.
		***	B16 Select Bell 103J when the modem is at 300 bps.
&B*n*	*n* = 1		**V.32 Auto Retrain**
		***	&B1 Enable V.32 auto retrain.
%B	n/a		**View Numbers in Blacklist** If blacklisting is in effect, this command displays the numbers for which the last call attempted in the previous two hours failed. In countries that do not require blacklisting, the ERROR result code appears.
C*n*	*n* = 1		**Carrier Control**
		***	C1 Normal transmit carrier switching (included for backward compatibility with some software).
&C*n*	*n* = 0 or 1		**Carrier Detect Control**
			&C0 Force Carrier Detect on.
		***	&C1 Let Carrier Detect follow carrier signal.
-C*n*	*n* = 0 or 1		**Data Calling Tone**
		***	-C0 Disable V.25 data calling tone.
			-C1 Enable V.25 data calling tone.
%C*n*	*n* = 0 or 1		**Data Compression Control**.
			%C0 Disable V.42bis / MNP 5 data compression.
		***	%C1 Enable V.42bis / MNP 5 data compression.

Command	Values		Description
D*s*	*s* = phone #		**Dial** Dial telephone number *s*, where *s* may include up to 40 alpha-numeric characters, and the **L**, **P**, **T**, **V**, **W**, comma (**,**), colon (**:**), semicolon (**;**), **!**, **$**, **@** and **^** dial string modifiers.
&D*n*	*n* = 0, 1, 2, or 3		**Data Terminal Ready Control** &D0 Modem ignores DTR signal. &D1 When DTR drops while in online data mode, the modem enters command mode, issues an OK, and remains connected.
		***	&D2 When DTR drops while in online data mode, the modem hangs up.
			&D3 When DTR drops, the modem hangs up and resets as if the **ATZ** command had been issued.
DS*n*	*n* = 0, 1, 2, or 3		**Dial Stored Telephone Number** Dial a number previous stored in directory number *n* by the **&Z*n*=*x*** command. For example, **ATDS3**.
E*n*	*n* = 0 or 1		**Echo Command Mode Characters** E0 Do not echo command mode characters.
		***	E1 Echo command mode characters.
+ES=6	n/a		**Enable Synchronous Buffered Mode** Allows an H.324 video application direct access to the synchronous data channel. On underflow, the modem sends the HDLC flag idle (0x7E) to the remote modem. This special error correction mode is overridden by any of the following commands: **&F**, **&M**, **&Q**, and **\N**. **+ES=?** Shows the only allowed value.
F*n*	*n* = 1		**Echo Online Data Characters**
		***	F1 Disable online data character echo (included for backward compatibility with some software.
&F*n*	*n* = 0		**Load Default Configuration**
		***	&F0 Load factory default values as active configuration.
&G*n*	*n* = 0, 1, or 2		**Guard Tones** (International model only)
		***	&G0 Turn off ITU-T guard tones.
			&G1 Turn on ITU-T 550 Hz guard tone.
			&G2 Turn on ITU-T 1800 Hz guard tone. **Note:** The U.K. model is locked to **&G2**, which turns on the ITU-T 1800 Hz guard tone.
\G*n*	*n* = 0		**Modem Port Flow Control**
		***	\G0 Returns an **OK** for backward compatibility with some software.

Command	Values		Description
H*n*	*n* = 0 or 1		**Hook Control**
		*** H0	Go on-hook (hang up).
		H1	Go off-hook.
I*n*	*n* = 0, 1, 2, 3, 4, or 9		**Information Request**
		I0	Display default speed and controller firmware version.
		I1	Calculate and display ROM checksum (for example, “12AB”).
		I2	Check ROM and verify the checksum, displaying **OK** or **ERROR**.
		I3	Display default speed and controller firmware version.
		I4	Display firmware version for data pump (for example, “94”).
		I9	Display country code (for example, “NA Ver. 1”).
&J*n*	*n* = 0		**Auxiliary Relay Control**
		*** &J0	The auxiliary relay is never closed.
\J*n*	*n* = 0		**Data Buffer Control**
		*** \J0	Enable data buffer — serial port speed is independent of connect speed
&K*n*	*n* = 0, 3, or 4		**Local Flow Control Selection**
		&K0	Flow control disabled.
		*** &K3	Enable CTS/RTS hardware flow control.
		&K4	Enable XON/XOFF software flow control.
\K*n*	*n* = 5		**Set Break Control**
		*** \K5	Modem sends break signal received from the DTE to the remote modem.
L	In dialing command		**Redial Last Number** Must be placed immediately after **ATD**.
L*n*	*n* = 0, 1, 2, or 3		**Monitor Speaker Volume**
		L0	Select low volume.
		L1	Select low volume.
		*** L2	Select medium volume.
		L3	Select high volume.
M*n*	*n* = 0, 1, 2, or 3		**Modem Speaker Control**
		M0	Modem speaker always off.
		*** M1	Modem speaker on until carrier signal detected.
		M2	Modem speaker always on.
		M3	Monitor speaker on during dialing, off during handshaking.

Command	Values		Description
&M*n*	*n* = 0		**Communications Mode**
		*** &M0	Asynchronous mode.
N*n*	*n* = 0 or 1		**Modulation Handshake**
		N0	Modem performs handshake only at communication standard specified by S37 and the **B** command.
		*** N1	Modem begins handshake at communication standard specified by S37 and the **B** command, but can fallback to a lower speed during handshake.
\N*n*	*n* = 0, 1, 2, 3, 4, 5, or 7		**Error Correction Mode Selection**.
		\N0	Non-error correction mode with data buffering (same as **&Q6**).
		\N1	Direct mode.
		\N2	MNP reliable mode.
		*** \N3	V.42\MNP auto-reliable mode.
		\N4	V.42 reliable mode.
		\N5	V.42, MNP, or non-error correction. Same as **\N3**.
		\N6	V.42, MNP, or non-error correction. Same as **\N3**.
O*n*	*n* = 0, 1, or 3		**Go Back On Line**
		O0	Exit online command mode and return to data mode.
		O1	Issue a retrain and return to online data mode.
		O3	Issue a rate renegotiation and return to data mode.
P	In dialing command		**Pulse-Dial** Modem pulse-dials numbers that follow P.
Q*n*	*n* = 0 or 1		**Result Codes Enable/Disable**
		*** Q0	Result codes sent.
		Q1	Result codes suppressed (quiet).
&Q*n*	*n* = 0, 5, or 6		**Asynchronous Communications Mode**
		&Q0	Asynchronous with data buffering. Same as **\N0**.
		*** &Q5	Error control with data buffering. Same as **\N3**.
		&Q6	Asynchronous with data buffering. Same as **\N0**.
\Q*n*	*n* = 0, 1, or 3		**Local Flow Control Selection**
		\Q0	Disable flow control. Same as **&K0**.
		\Q1	XON/XOFF software flow control. Same as **&K4**.
		*** \Q3	RTS/CTS hardware flow control. Same as **&K3**.

Command	Values		Description
S*r*=*n*	*r* = 0–8, 10-11, 28, 35, 37, 42-43, or 89; *n* varies		**Set Register Value** Set value of S-register *r* to value of *n*, where *n* is entered in decimal format.
S*r*?	*r* = 0–8 10-11, 28, 35, 37, 42-43, or 89		**Read Register Value** Read value of S-register *r* and display value in 3-digit decimal form.
&S*n*	*n* = 0 or 1		**Data Set Ready Control** 48 pin *** &S0 Force DSR high (on). &S1 Let DSR follow CD.
T	In dialing command	***	**Tone-Dial** Modem tone-dials numbers following the T.
&T*n*	*n* = 0, 1, 3 or 6	n/a	**Self-Test Commands** &T0 Stop any test currently in progress. &T1 Local analog loop test. &T3 Local digital loopback test. &T6 Remote digital loopback test.
\T*n*	*n* = 0		**Inactivity Timer** *** \T0 Disable inactivity timer.
V	In dialing command		**Switch to Speakerphone Mode** Switches to speakerphone mode and dials the following number. Use **ATH** command to hang up.
V*n*	*n* = 0 or 1		**Result Codes (Verbose/Terse)** V0 Result codes sent as digits (terse response). *** V1 Result codes sent as words (verbose response).
&V	n/a		**View Current Configuration** Display the active modem settings.
\V*n*	*n* = 0 or 1		**Protocol Result Code** \V0 Do not append protocol result code to DCE speed. *** \V1 Append protocol result code to DCE speed.
W	In dialing command		**Wait for New Dial Tone** Causes modem to wait for new dial tone. (**X2**, **X4**, **X5**, **X6**, or **X7** must be selected.)
&W*n*	*n* = 0		**Store Configuration** &W0 Store current settings in NVRAM; modem will load these at power-on or with the **ATZ** command instead of reading factory ROM

Command	Values		Description
			defaults.
X*n*	*n* = 0–7		**Result Codes and Call Progress Selection**
			X0 Basic result codes (CONNECT only); does not look for dial tone or busy.
			X1 Extended result codes (w/ CONNECT 1200, CONNECT 2400, etc.); does not look for dial tone or busy signal.
			X2 Extended result codes with NO DIAL TONE; does not look for busy signal.
			X3 Extended result codes with BUSY; does not look for dial tone.
		***	X4 Extended result codes with NO DIAL TONE and BUSY.
			X5 Extended result codes with NO DIAL TONE and BUSY.
			X6 Extended result codes with NO DIAL TONE and BUSY.
			X7 Basic result codes with NO DIAL TONE and BUSY.
\X*n*	*n* = 0		**XON/XOFF Pass-Through**
		***	\X0 Respond to and discard XON\XOFF characters.
Y*n*	*n* = 0		**Long Space Disconnect**
		***	Y0 Disable sending or responding to long space break signal on disconnect.
&Y*n*	*n* = 0		**Select Stored Configuration for Hard Reset**
		***	&Y0 Select stored configuration 0 at power-up (included for backward compatibility with some software.)
Z	n/a		**Modem Reset** Reset modem to default values. Defaults come from NVRAM if **&W0** is set, from ROM if **&W1** is set.
&Z*n*=*x*	*n* = 0-3, *x* = dialing string.		**Store Telephone Number** Stores telephone dial string *x* in memory location *n*. Dial the stored number using the command **ATDS=*n***.
,	In dial command		**Dialing Pause** Comma; causes dialing pause for time set by **S8**.
;	At end of dial command		**Return to Command Mode After Dialing** Semi-colon; causes immediate return to command mode after dialing.
!	In dial command		**Flash On-Hook** Exclamation; causes modem to flash on-hook.
$	In dial command		**Detect Call Card** Causes the modem to pause and wait for an AT&T call card “bong” or a 1600 Hz tone before processing

Command	Values	Description
		the rest of the dial string.
@	In dial command	**Quiet Answer** Causes modem to wait for a ringback, then 5 seconds of silence before processing next part of command.
^	In dial command	**Disable Data Calling Tone Transmission** The modem does not transmit data calling tones.
+++AT<CR>		**Escape Sequence** Puts modem in command mode while still remaining on line. Type **+++** followed by the letters **A** and **T**, up to ten command characters and a RETURN.

* Factory default on International model

** Not available on U.K. model

*** Factory default on North American model

Glossary

A

AC (Alternating Current): A power source whose signal crosses a reference voltage (usually called ground or zero). Alternating between a maximum and minimum voltage, AC may also be referred to as a bi-polar signal. Contrast with DC.

ACK (ACKnowledgment code – pronounced "ack"): A communications code sent from a receiving modem to a transmitting modem to indicate that it is ready to accept data. It is also used to acknowledge the error-free receipt of transmitted data. Contract with NAK.

ACS (Asynchronous Communications Server): A communications server that managers a pool of modems for shared use over the LAN. It directs outgoing messages to the next available modem and directs incoming messages to the appropriate workstation. It also provides conversion between LAN packets and asynchronous format.

Address: A numbered location inside a computer. It's how the computer addresses its resources, like a video card, serial ports, memory, etc.

Algorithm: A set of ordered steps for solving a problem. This can be a mathematical formula or the instruction in a computer program.

Alphanumeric: The basic character set which includes the letters A to Z (and a to z) and the digits 0 to 9.

Amplitude: The difference between the maximum and minimum voltages of a waveform expressed as a "peak-to-peak" voltage.

Amplifier: An active device within a circuit which increases the voltage level of all signals (desirable and undesirable).

Analog loopback: A modem diagnostic used to test either the local analog loop (the modem's internal circuitry) or the remote analog loop (the telephone line). The local analog loop test is accomplished by activating the self-test mode and tying the modem's modulator to its demodulator and examining the return stream of data at the PC or terminal it services. The remote analog loopback can only be activated on four-wire leased line connections with a remote modem capable of performing the same test.

Analog signal: A waveform which has amplitude, frequency and phase, and which takes on a range of values between its maximum and minimum points. Analog implies continuous movement from point A to point B, as opposed to discrete jumps. For example, sound is continuously varying air vibrations and is converted into analogous electric signals to be carried on a telephone line.

Analog Transmissions: One of two types of telecommunications which uses an analog signal as a carrier of voice, data, video, etc. An analog signal becomes a carrier when it is modulated by altering its phase, amplitude and frequency to correspond with the source signal. Compare with digital transmission.

ANSI (American National Standards Institute – pronounced "ansy"): A U.S. standards organization supported by over 1000 companies and trade organizations. It is a non-profit, non-government group that is the U.S. member of the ISO (International Standards Organization).

ANSI character set: An 8-bit character set that contains 256 characters. The first 128 characters are alphanumeric and the second 128 contain math and foreign language symbols.

API (Application Programming Interface): The language and message format used by a program to activate and interact with functions in another program or in the hardware. A software module which provides a uniform interface for otherwise incompatible programs.

ASCII (American Standard Code for Information Interchange – pronounced "askey"): A binary code for data that is used in communications and in many computers and terminals. The code is used to represent numbers, letters, punctuation and control characters. The basic ASCII code is a 7-bit character set, which defines 128 possible characters. The extended ASCII file provides 255 characters.

Associate: Establishing that all files with a given extension are usable by a certain application.

Asynchronous Transmission: The transmission of data in which each character is a self-contained unit with its own start and stop bits. This is a common method of transmission between a computer and a modem. One character at a time, encoded into a series of electrical pulses, is transmitted or received. This is the oldest method of data transfer. When it is used with error correcting software and data compression algorithms, along with the increase it maximum attainable speeds, it continues to be a viable alternative to synchronous transmission.

ATM (Asynchronous Transfer Mode): A high speed switching technique suitable for MAN's (Metropolitan Area Network) and broadband ISDN transmission.

Auto Answer: A modem feature which enables the modem to "off-hook" when it detects an incoming call.

Auto Dial: Some modems provide this feature for asynchronous dialing. This feature is a pre-defined macro that allows the user to enter the location of a phone number (i.e. N0 through N9) and have the modem go off-hook, dial and establish the connection. With the auto dial feature, an asynchronous terminal can establish a dialing directory without running a communication software package.

AUTOEXEC.BAT (AUTOmatic EXECute BATch): A DOS batch file that executes when the computer is started. This file contains the basic start-up commands that help configure the system.

Automatic Dialer: A device which is programmed to place a call to a predetermined number any time it is taken "off-hook".

B

Background: An activity that takes place in the PC while you are running another application. In other words, the active user interface does not correspond to the 'background' task. In Windows™, the area behind the active window. Compare with foreground.

Backup: Additional resources or duplicate copies of data on different storage media for emergency purposes.

Band: The range of frequencies between two defined endpoints.

Bandwidth: The transmission capacity of a computer channel, communications line or bus. It is expressed in cycles per second (hertz), the bandwidth being the difference between the lowest and highest frequencies transmitted. The bandwidth of a phone line is about 3000Hz with QAM, you get up to 14,400 bps. Bandwidth is often stated in bits or bytes per second.

Baseband signal: An unmodulated signal which is transmitted at its original frequency and may be digital or analog.

Baud: Rate, the signaling rate of a line, the switching speed, or the number of transitions (voltage or frequency changes) that are made per second. Transmission speeds are often expressed in baud, though bits per second is more accurate. The speed at which your computer talks to your modem.

BCC (Block Check Character): An error control method used in character-oriented or byte-synchronous protocols. Two 8-bit BCC's are used to create the CRC (Cyclic Redundancy Check) field of a synchronous data packet.

Bell 103: The U.S. modulation standard for 300 bps full-duplex transmission over dial-up lines.

Bell 201: The U.S. modulation standard for 2400 bps half-duplex transmission over dial-up lines or full-duplex transmission over 4-wire lines. Primarily used in synchronous modems.

Bell 202: The U.S. modulation standard for 0-1200 bps, half-duplex transmission over 2-wise, or full-duplex transmission over 4-wire leased lines.

Bell 208: The U.S. modulation standard for 4800 bps, half-duplex transmission over dial-up lines, or full-duplex transmission over 4-wire lines. Primarily used in synchronous modems.

Bell 212A: The U.S. modulation standard for 1200 bps full-duplex transmission over dial-up lines.

Binary: A numbering system based on two digits, 1 and 0, which is conductive to the two-state digital electronics used within computers. All input to a computer is encoded as a binary value. Binary also refers to a file format that uses 8-bit characters , to allow for control characters (i.e., all non-ASCII files).

BSC (Binary Synchronous Communications): Also called "bisync", this communications protocol was the first synchronous data format used by IBM. It is still in use, but is rapidly being replaced by IBM's newer Synchronous Data Link Control (SDLC). Bisync is a byte-synchronous protocol that has longer delays and more overhead that the bit-synchronous SDLC. It uses two synchronization characters to head every packet.

Bit (Binary DigIT): A bit is the basis of the binary number system. It can take the value of 1 or 0. Bits are generally recognized as the electrical charge generated or stored by a computer that represents some portion of usable information.

Bit-synchronous transmission: A synchronous form of data transmission that focuses on a maximum packet size rather than the length of the characters the packet contains. SDLC is a bit-synchronous protocol.

Boot: Starting or restarting your PC. This term originates from the saying "to pull oneself up by the bootstraps".

Bps (bits per second): A unit to measure the speed at which data bits can be transmitted or received. Bps differs from baud when more than one bit is represented by a single cycle of the carrier.

Break-out box: An electronic device which is inserted between two RS232/V.24 connectors for the monitoring of pin activity and for the re-routing of lines (crossover).

Broadcast: To send information simultaneously to a group of recipients.

Buffer: A temporary storage register or Random Access Memory (RAM), used in all aspects of data communications which prevents data from being lost due to differences in transmission speed. Keyboards, serial ports, muxes and printers are a few examples of the devices that contain buffers. A buffer allows one device to dump data at a high speed and for the lower-speed device to accept it at its own pace. In this way, the high-speed device can continue to work without having to wait for its data transfer to end. Buffers are a way of preventing potential data loss.

Bus: A common channel between hardware devices either internally between components in a computer, or externally, between stations in a communications network.

Byte: The unit of information a computer can handle at one time. The most common understanding is that a byte consist of 8 binary digits (bits), because that's what computers (PCs) can handle. A byte holds the equivalent of a single character, such as the letter "A".

C

CAD (computer aided design - pronounced "kad"): A computerized system used to design products. CAD systems are high speed workstations or PCs that use CAD software and input devices, such as graphic tables and scanners.

Callback security: A security feature available in some intelligent modems that stores phone numbers. When activated, the user calling the secured modem must furnish a recognized password, and then provide a code that corresponds to one of the stored phone numbers. When these security measures are met, the secured modem hangs up on the caller and dials the appropriate number to establish a data communications link.

Capacitor: An electronic device that stores an electrical charge. It comes in varying sizes for use in anything from power supplies to the tiny cells in dynamic RAM chips. When the device is powered down, it's capacitors lose their charge.

Carrier signal: An analog signal with known frequency, amplitude and phase characteristics used as a transport facility for useful information. By knowing the original characteristics, a receiver can interpret any changes as modulations, and thereby recover the information.

Character set: One of a number of coding schemes which uses binary digits to represent characters, numbers, punctuation, and/or control characters. Common character sets are ASCII, ANSI, and EBCDIC.

Checksum: A control field found in synchronous data packets which contain the results of the error control algorithm used.

Chip: Also called integrated circuits (IC), they are squares or rectangles that contain from a few dozen to a few million electronic components.

CHKDSK (pronounced "check disk"): An external DOS command that reports free memory and disk space. CHKDSK must be run directly from DOS or within a batch file.

Circuit: Any closed path through which electrical current can flow.

Circuit-switched Network: A technology used by the PSTN that allocates a pair of conductors for the exclusive use of one communication path. Circuit switching allows multiple conversations on one talk path only if the end-users multiplex the signals prior to transmission.

Circuit switching: The temporary connection of two or more communications channels using a fixed, non-shareable path through the network. Users have full use of the circuit until the connection is terminated.

Clipboard: An electronic holding place for the most recent cur or copy made from a document. Whatever is on the clipboard can be pasted into the current document. Only one item may be on the clipboard at a time. When new copy is sent to the clipboard the existing copy is eliminated. When you shut down your computer, whatever is on the clipboard is lost.

Clock: A timing signal generated by an oscillating circuit which is used to synchronize data transmissions.

Command: An instruction that tells a computer to begin, continue, or end a specific operation.

Command mode: One of two states of an intelligent (programmable) device. The mode in which commands can be issued to alter operating parameters.

Communications Server: Also known as the Async Gateway, it is a PC equipped with the appropriate hardware and software package so it can function as a gateway between a LAN and its modems or host connections.

COMx Port: A serial communications port on a PC.

CONFIG.SYS file (pronounced "config dot sis"): A text file that contains configuration commands used when you start your computer. Commands in the CONFIG.SYS file enable or disable system features, set limits or resources, and extend the operating system's purpose by loading device drivers.

Cooked data: A term used in UNIX communications to identify the UNIX command-line data transmitted. This type of data is noted for a reduction in effective throughput because it has to be processed, or "cooked" prior to transmission. Compare with raw data.

CPU (central processing unit): The computing part of the computer. It is made up of the control unit and the ALU (arithmetic logic unit). The CPU, clock and main memory make up a computer. When you turn on your computer, an electrical signal follows a permanently programmed path to the CPU to clear the leftover data from the chips' internal memory registers.

CRC (Cyclic Redundancy Check): A field used in packetized data that contains two 8-bit BCCs (Block Check Characters) as the binary result of an algorithm performed

on the data bits in the packet. A CRC is used for error detection by many synchronous protocols.

CTS (Clear To Send signal): With communications between modems, an RSs-232 signal sent from the modem to the DTE that indicates it is ready to accept data. Contract with RTS.

D

DAA (Data Access Arrangement): The circuitry to isolate any device from phone lines and their associated equipment.

Daisy-chain: A method of connecting multiple devices in a series, one after another.

Data compression: The process of reducing the data bits necessary to represent useful information. By compressing files, less storage is required and higher throughputs are realized.

Data Pump: The DAC (Digital-to-Analog Conversion) circuitry used within a modem.

DB-25: A very common 25-pin connector often referred to as an RSs-232 connector because it is the connector over which the RS-232 interface commonly occurs.

DB (Direct Current): Usually understood to mean a constant voltage supply that fluctuates only a nominal amount. An analog or digital signal that may vary in voltage level, but it never crosses the reference voltage (usually called ground). Contrast with AC>

De facto standards: A de facto standard is one of two types of voluntary standards recognized by a given market. It is introduced by a single vendor and becomes a standard by its widespread use and acceptance by other vendors. AT&T's Bell 212A, IBM's Binary Synchronous Protocol, or DEC's VT-100 terminal protocol are examples of de facto standards. Compare with de jure standards.

De jure standards: A de jure standard is one of two types of voluntary standards. It represents the collective consensus of the industry and users for a particular aspect of manufacturing. CCITT's V and X standards (V.32 and Xx.25) are examples of de jure standards. Compare with de factor standards.

Decibel (dB): A unit of measurement for signal strength based on logarithmic increments, A decibel is a relative measurement that is derived from an initial reference level and a final observed level.

Default: A preset value or option, in software packages, or in hardware configuration, that is used unless you specify otherwise.

Device driver: Software that controls how a computer communicates with a device, such as a printer or mouse.

Digital signal: Digital devices, such as terminals and computers, transmit data as a series of electrical pulses which have discrete jumps rather than gradual changes.

Digital Transmission: A method of electronic information transmission common between computers and other digital devices. Analog signals are waveforms: a combination of many possible voltages. A computer's digital signal may be only "high" or "low" at any given time. Therefore, digital signals may be "cleaned up" (noise and distortion removed) and amplified during transmission.

DIP switch: A set of tiny toggle switches, built into a DIP (dual in-line package), used for setting configurable parameters on a PCB (printed circuit board).

Directory: A logical subdivision of a computer's disk space used to organize a group of files. A directory can be thought of as a file drawer.

DOS (Disk Operating System - pronounced "daws"): The software that allows all the hardware in a PC to interact. The basis for (DOS prompt) higher level applications.

DOS prompt: The > symbol displayed after the disk drive letter.

DPSK (Differential Phase Shift Keying): A common form of phase modulation used in modems. It does not require complex demodulation circuitry and is not susceptible to random phase changes in the transmitted waveform, thus reducing errors during transmission.

Driver: A software module that interfaces between the Operating System and a specific hardware device, such as a color monitor, printer or hard disk. Also known as a device driver.

DSR (Data Set Ready): An RS-232 signal sent from the modem to the computer or terminal indicating that it is able to accept data. Contrast with DTR.

DTE (Data Terminating Equipment): A term used to include any device in a network which generates, stores, or displays user information. DTE is a telecommunications term which usually refers to PCs, terminals, printers, etc.

DTMF (Dual-Tone MultiFrequency): A generic push-button concept made popular by AT&T TouchTone.

DTR (Data Terminal Ready): An RS-232 signal sent from the computer or terminal to the modem indicating that it is able to accept data.

E

EBCDIC (Extended Binary Coded Decimal Interchange Code - pronounced "eb suh dick"): An IBM character code used in its mainframe and midrange computers. It is an 8-bit code (256 combinations) that stores one alphanumeric character or two decimal digits within a byte. EBCDIC and ASCII codes are the most common codes used to represent data.

Echo: The reflection or duplication of a signal back toward its source. Echoing is useful when a terminal is transmitting data, in that the data can be echoed to the screen so the user can monitor what is being sent. Echoing is undesirable when it refers to the signal which results on a telephone line from impedance mismatches.

Echo cancellation: a high speed modem technique that isolates and filters out unwanted signals caused by echoes from the main transmitted signal. This allows full-duplex modems to send and receive on the same frequency carrier.

EIA (Electronics Industries Association); A membership organization founded in 1924 that includes manufactures of electronic parts and systems. With over 1200 members, it sponsors shows and seminars, and gives awards for outstanding contributions in electronics. It sets electronic interface standards, such as RS-23.

EISA (Enhanced Industry Standard Architecture - pronounced "eesa"): The purpose of the EISA bus was to provide a 32-bit bus for faster throughputs while maintaining backward compatibility with the classic ISA bus architecture.

Emulation: The process of one type of device imitating another via a hardware or software package. Terminal emulation, for example, allows a PC to access a mainframe computer by generating and accepting data like a "dumb" terminal.

Environment: A computer configuration that includes the CPU model and system software (operating system, data communications and database systems). It may also include the programming language used. It sets the standards for the applications that run in it.

EPROM (Erasable Programmable Read Only Memory - pronounced "eeprom"): A reusable PROM chip that holds its contents until erased under ultraviolet light.

Error correction: The process of detecting distorted data bits and requesting a retransmission or interpretation to correct the error. Errors are introduced by bad line conditions or external interface.

F

Fax (facsimile): Refers to the bit-mapped rendition of a graphics-oriented document (fax) or to the electronic transmission of the image over telephone lines (faxing). Fax transmission differs from data transmission in that the former is a bit-mapped approximation of a graphical document and, therefore, cannot be accurately interpreted according to any character code.

Fax card: An expansion card that, with the appropriate software, allows a PC to operate as a fax transmitter/receiver. PC fax cards may be able to send and receive faxes from a file on the PC> If an external scanner is available, the PC can also transmit the scanned image via the fax card.

Fax/Data-Modem: A multifunctional device capable of transmitting either data or faxes. It is available as an external unit or expansion board. It includes a fax switch that routes the call to the fax or the data modem.

Fax server: A network resource that allows workstation PCs to transmit faxes as though the PC had an internal fax card or a fax modem attached.

Firmware: A category of memory chips that hold their content without electrical power. They include ROM, PROM, EPROM, and EEPROM technologies. Firmware becomes "hard software" when holding program code.

Flash Memory: A memory chip that holds its content without power, but must be erased in bulk. The term comes from its ability to be erased "in a flash". Flash memory is derived form EEPROM, but are less expensive and provide higher bit densities.

Floppy Disk: Also called a diskette. It is a round disk with a hole in the middle, made of flexible material and houses in a square envelope or cartridge. A disk drive holds the floppy disk through the hole in its center and spins it within its envelope. They can be used over and over again. Contrast with hard disk.

Flow control: The process of regulating the speed at which data enters or leaves a serial port. Software flow control is implemented by communications software or by the user sending predefined characters or packets which are recognized as "pause" and "resume" indicators. Hardware flow control is achieved by using the RTS (request to send) and the CTS (clear to send) control lines of the RS-232 interface.

Footprint: The desk or floor space that a piece of hardware occupies. Also referred to as "real estate".

Foreground: The application program currently running on, and in control of, the PC screen and keyboard. The area of the screen that occupies the active window. Compare with background.

Format:

1. The way text is set up on a page.

2. To prepare a disk for holding information. Formatting a disk can delete all information that was previously on it.

3. The information is structured in a file, often specific to one application or protocol.

Frequency: A characteristic of an electrical or electronic signal which describes the periodic recurrence of cycles. Frequency is inversely proportional to the wavelength or pulse width of the signal.

FSK (Frequency Shift Keying): A technology that establishes two frequencies used to represent binary values. This was the earliest type of modulation used by 300 bps modems.

Full-duplex: A method of transmitting and receiving data simultaneously over a single pair of wires. Compare with Half-Duplex.

G

Gateway: A workstation which serves as a protocol converter (translator) between two or more dissimilar networks, providing incompatible systems.

H

Half-Duplex: The transmission of data in both directions, but only one direction at a time. Compare with Full-Duplex.

Handshaking: A process that two modems go through at the time of call setup to establish synchronization over the data communications link. It is a synchronization and negotiation process, accomplished by the exchange of predefined, mutually recognized control codes.

Hard Disk: A metal disk covered with magnetic recording material. Some can hold up to several gigabytes of information. Contrast with floppy disk.

Hardware: The equipment that makes up your computer system, including the keyboard, mouse, disk drives, and monitor.

Hexadecimal: A base 16 numbering system used to represent binary values. Hex uses the numbers 0-9 and the letters A-f; usually notated by an "h" (as in "4CF h", read as "four charley fox, hex"). The result is that one hex digit represents a four-bit value.

Host: The computer that is designated as retaining information or processing power to service the needs of other computers or terminal. Mainframes and mid-range computers are hosts, as well as PCs with powerful microprocessors. Often a PC on a LAN will be set up as a host to provide LAN access for remote users.

I

I/O Addresses: Locations within the I/O address space of your computer used by a device, such as an expansion card, a serial port, or an internal modem. The address is used for communication between software and a device.

Initialize: To begin anew and establish start-up parameters. This typically involves clearing all or some part of the device's memory or disk space.

Interface: A common meeting ground supplied by hardware or software to facilitate a compatible connection and operation between two devices or programs. For example, when two PCs are connected they use a common interface across the physical connectors so that the signals being sent and received are accurately interpreted. With software, an interface is a module created to be "written to". That is, if two programs are written to the same interface, they can be successfully linked together.

IPX (Internet Packet Exchange): A data transport protocol developed by Novell used to route messages from one node to another. Application programs that manage their own client/server or peer-to-peer communications in a Novell network can access IPX directly. IPX does not guarantee the delivery of a message. Compare with SPX.

IRQ Level (Interrupt Request Level): The notification a processor receives when another portion of the computer's hardware requires its attention. IRQs are numbered so that the device issuing the IRQ can be identified, and so IRQs can be prioritized.

ISA (Industry Standards Architecture - pronounced "ice a"): The classic 8 or 16-bit architecture introduced with IBM's PC-AT computer. Due to speed constraints, IBM introduced a restructured Micro Channel Architecture with a 32-bit bus and increased addressing capabilities.

ISDN (Integrated Services Digital Network): International telecommunications standard for transmitting voice, video and data over a digital communications line.

ISI (Intelligent Serial Interface): Multi-Tech's multiport serial card with an on-board processor and 50K or RAM for data buffering. The ISI does more than provide additional serial ports. It enhances the serial port performance with the data buffering, and it holds the data it receives until an entire block can be transferred to the processor. This allows the computer's processor to be interrupted less often, so it can perform more efficiently.

J

Job: The unit of work being processed by the computer.

K

Kermit: An asynchronous file transfer protocol noted for its accuracy over noisy lines.

Kernel: The core of an operating system which interacts directly with the system hardware. While most operating systems are based on the concept of a kernel, the term is best recognized as a fundamental of the UNIX operating system. Kernels have been expanded to include commonly-used utilities, but with the advent of the "micro kernel", the original modular design of UNIX is being revived.

Kilobit: One thousand bits. A unit of measure for digital data rates.

Kilobyte: One thousand bytes. A unit of measure for digital data rates. Not to be confused with "K", which stands for z^{10} bytes of storage space, either in memory or on disk. 1K of disk space is actually 1024 bytes. 16K is 65,536 bytes, and 1M (meg) is 1,048,576 bytes.

L

LAM (Line Adapter Module): The cabling that connects the phone line to the PCMCIA modem card.

LAN Card: An IC Card that complies with the PCMCIA Card Services Interface Specification, Release 2.0. LAN cards can be connected to laptops or palmtop computers which, in turn, can be interconnected to local LAN services.

Leased Line: A private, dedicated communications channel that connects two locations. This connection lasts for the duration of the subscription. Leased lines may be conditioned to improve line quality over that of dial-up lines.

Line Conditioning: An additional cost option offered by the telephone company for their leased, voice-grade lines. The service provides a careful balance of line enhancements to improve the frequency response and to reduce distortion.

LPTx (Line Printer): The parallel port interface on a PC. It provides a 25-pin connector for parallel transfer of data and printer controls, commonly used for parallel printers. A maximum of four I/O addresses are set with DOS parameters LPT1, LPT2, LPT3 and LPT4.

LRC (Longitudinal Redundancy Check): An error checking method that generates a parity bit from the specified string of bits on a longitudinal track. In a row and column format such as on magnetic tape, LRC is often used with VRC, which creates a parity bit for each character.

M

Macro: A series of keystrokes, commands, and/or menu selections that have been recorded and assigned a key or key combination. When those keys are pressed, the macro is executed from beginning to end.

Magnetic Disk: A non-volatile computer storage device that uses one or more magnetic-coated disk platters that can be recorded over and over again. Hard disks, minifloppies (5-1/4") and microfloppies (3-1/2") are examples of magnetic disks.

Mainframe: A large, powerful computer used to centralize a data processing environment. It has hundreds of gigabytes of storage space. It uses a frond end processor to connect directly to the communications channels that interconnect terminals and computers.

Megabyte: One million bytes, when describing a data rate. 1M of disk space may actually mean 1,048,576 bytes.

Mid-range computer: A term coined by IBM, referring to any of their Advanced Business Systems computers. This product line was originally called their mini-computers, but as the number of supported users approached mainframe capabilities, the term "mid-range" caught on.

MI/MIC (mode indicate/mode indicate common interface): A user definable feature that defines various combinations of edge or level detection in Originate or Answer mode, with the Ring Indicator (RI) pulse enabled or disabled.

Mnemonics: A term assigned to a complex idea, value, or list of information which is found to be representative of that information. Computer commands are almost entirely mnemonics. Mnemonics are used as memory aids for people.

MNP (Microcom Networking Protocol): A family of communications protocols from Microcom that have become de facto standards for error correction and data compression.

MNP Class 3&4: The de facto error correction standard from Microcom.

MNP Class 5: The most widely used data compression scheme before V.42*bis* took hold. MNP5 offers "2-to-1" data compression.

MNP Class 7: MNP's "3-to-1" data compression scheme. MNP7 never became a de facto standard because of V.42*bis* "4-to-1" compression.

Modem: A communications device that enables a computer to transmit information over a telephone line. It converts the computer's digital signals into analog signals to send over a telephone line and converts them back to digital signals at the receiving end. Modems can be internal and fit into an expansion slot, or external and connect to a serial port.

Modulation: The process of encoding information from one signal (called the source) into another (called the carrier) by modifying some characteristic(s) of the carrier. It is often used in telecommunications when one type of signal must be converted for transmission over an otherwise incompatible medium.

Multiplexer (mux): A device that merges several signals into one composite signal for transmission over a single medium or channel. A de-multiplexer (usually built into a mux) reverses the process at the receiving end.

N

NAK (Negative Acknowledgment): Communications code used to indicate that a message was not properly received, or that a terminal does not wish to transmit. Contrast with ACK.

Network: A group of computers connected by cables or other means and using software that enables them to share equipment, such as printers and disk drives to exchange information.

NIC (Network Interface Card - pronounced "nick"): A printed circuit board that provides the physical and electrical connection between a PC and a network device (like a file server) via a network media (like Arcnet UTP).

Node: Any point within a network which has been assigned an address.

Normal mode: In modem operation, this refers to a mode of operation without error correction active.

O

OCR (Optical Character Recognition): The recognition of printed characters and subsequent translation into character code for use on a computer. OCR systems can recognize many different fonts, as well as typewriter and computer-printed characters. Advanced OCR systems can recognize hand printing.

Off-hook: The condition of a device which has accessed a phone line (with or without using the line). In modem use, this is equivalent to a telephone handset being picked up. Dialing and transmission are allowed, but incoming calls are not answered.

OS (Operating System): The master control program that runs a computing system. It is the first program loaded when the computer is turned on, and its main part is called the kernel and resides in the memory at all times.

P

Parameter:

1. A "place holder" in a command which should be substituted with useful information.
2. The list of acceptable values for a given option or command.

Parity bit: An extra bit attached to each byte of synchronous data used to detect errors in transmission.

PCB (Printed Circuit Board): A flat board that holds chips and other electronic components. The board is "printed" with electrically conductive pathways between components. The main PCB in a system is called a motherboard and the smaller PCBs that plug into the slots in the motherboard are called daughter boards or cards.

PCMCIA (Personal Computer Memory Card International Association): An organization of U.S. and Japanese companies set up to standardize memory cards and other architecture-independent expansion devices. These cards are typically used in laptop computers.

Phase: The timing of a signal based upon the starting point of each cycle in another signal. To be detected, phase requires the comparing of two signals. If the cycle of two signals begin at the same point, they are said to be "in-phase". In-phase signals add, while out-of-phase signals tend to cancel each other.

Port: A location for input or output data exchange. Computers, muxes, etc., have ports for various purposes.

Print Server: A computer in a network that controls one or more printers. It stores the print image output from all users of the system and feeds it to the printer one job at a time. The print server may be part of the network operating system or an add-on utility.

Program: A collection of computer instructions that tell the computer what to do.

PROM (Programmable Read Only Memory): A permanent memory chip that can be programmed or filled by the customer after the manufacturer has set initial values. Contrast with ROM.

Prompt: A request for information from the PC that provides required input or information.

Protocol: A set of rules that defines how computing devices communicate with each other. The rules governing the transmitting and receiving of data.

PSK (Phase Shift Keying): A modulation technique which establishes two-bit elements, called "dibits" yielding four possible combinations: 00,01,10,11. These element are then represented by 90, 180 and 270 degree angles. PSK produces the appropriate shift in phase relative to the original carrier. Differential PSK replaces this technology because it is less prone to error. Modems using PSK normally operate at 1200 bps.

PSTN (Public Switched Telephone Network): A worldwide public voice telephone network that is used as a telecommunications medium for the transmission of voice, data and other information.

Pulse dialing: One of two methods of dialing a telephone, usually associated with rotary dial phones. Compare with tone dialing.

Pulse-width: Pertaining to a digital signal. Pulse width refers to the duration of one state between clocking signals. Pulse width roughly corresponds to an analog signal's wavelength.

Q

QAM (Quadrature Amplitude Modulation): A complex method of modulation that establishes twelve phase angles and four amplitudes, designating sixteen possible combinations. QAM encodes hexadecimal values (also called quadbits) into one cycle of the carrier. Using a 1800 bps carrier frequency and a 2400 baud signaling rate, QAM provides a 9600 bps modulation speed. However, because it uses amplitude modulation, QAM is susceptible to noise.

Queue: A set of activities that are waiting in chronological order for an action, such as printing, to be performed.

R

Rack: A frame or cabinet into which components are mounted. The industry standard rack is 19" wide and has variable depth and height.

Rackmount: A packaging style available for many types of electronic equipment which enables the installer to mount the equipment in an industry standardized enclosure. The rackmount equipment is fitted with brackets, rather than being packages in its own enclosure. Rackmounting conserves disk and floor space (real estate) and often conserves power outlets.

RAM (Random Access Memory): A computer's primary workspace. All data must be stored in RAM (even for a short while), before software can use the processor to manipulate the data. Before a PC can do anything useful it must move programs from disk to RAM. When you turn it off, all information is RAM is lost.

Reboot: Restarting your PC by turning off the power and then turning it back on, or by pressing Alt,Ctrl and Del keys at the same time. Warm boot=Ctrl+Alt+Del (soft boot) or Cold boot=Power switch (hard boot).

Repeater: A device that amplifies or regenerates the data signal in order to extend the distance of the transmission. This can be used with both analog and digital signals, and is used extensively in long distance transmission to keep signals from losing their strength.

Resolution: Indicates the number of dots that make up an image on a screen or printer. The more dots, the higher the resolution, and the finer and smoother the images can appear when displayed at a given size.

RJ-11: An industry standard interface used for connecting a telephone to a modular wall outlet; comes in 4-and 6-wire packages.

RJ-45: An 8-wire modular connector for voice and data circuits.

ROM (Read Only Memory): A memory chip that permanently stores instructions and data. Its contents are created at the time it is manufactured and cannot be altered. ROM is used to store control routines in PCs and peripheral controllers. ROM is also used in the plug-in cartridges for printers and video games. A set of ROM chips contain the basic input/output system (BIOS).

RS232-C: An EIA standard for a serial interface between computers and peripheral devices (modem, mouse, etc.). It uses a 25-pin DB-25, or a 9-pin DB-9 connector. The RS232 standard defines the purposes, electrical characteristics and timing of the signals for each of the 25 lines.

RTS (Request To Send signal): With communications between modems, an RS232 signal sent from the DTE to the modem requesting permission to transmit. Contrast with CTS.

S

Scanner: A hardware device that can "read" a photograph or other piece of artwork and transforms it into a collection of dots that can be stored as a bit-mapped file on a hard drive. It can then be manipulated into various software programs and placed electronically in a page layout program.

SDLC (Synchronous Data Link Control): In IBM's SNA networks, this is the primary data link protocol.

Serial Port: The connector on a PC used to attach a serial device (a device that need to receive data one bit after another), such as a mouse, printer or modem. It consists of a 9- or 25-pin connector that sends data in sequence. Serial ports are referred to as "COMx" ports, where x is 1 to 4 (COM1 through COM4). A serial port contains a conversion chip called a UART, which translates between internal parallel and external serial formats.

Server: A computer that provides disk space, printer access, or other shared services, to computers over a network.

Software: The set of instructions that make computer hardware perform tasks. Programs, operating systems, device drivers and applications are all software.

Spoofing: A command recognized by modems which have been manufactured specifically for use within the UNIX UUCP (UNIX to UNIX Copy) facility. Spoofing is the process of transparently disabling the "g" protocol used by UUCP and substituting the modem's own error correction protocol for data integrity. The process "spoofs" the UNIX host into

transmitting data faster than normal, because the acknowledgments are actually sent by the modem instead of the remote UNIX computer.

Spooling (Simultaneous Peripheral Operations On-line): Overlapping a low-speed operation with normal processing, such as printing a file or document in the background while creating a new document in the foreground.

SPX (Sequenced Packet Exchange): A data transport protocol developed by Novell used for interprocess communications. It guarantees that an entire message arrives intact and uses the NetWare IPX protocol as its delivery mechanism.

Switch Line: In communications, a physical channel established by dynamically connecting one or more discreet segments. This connection lasts for the duration of the call after which each segment may be used as part of a different channel. Contrast with leased line.

Switched Network:

A network in which a temporary connection is established from one point via one or more segments.

Synchronous Transmission: The transmission of data which involves sending a group of characters in a packet. This is a common method of transmission between computers on a network or between modems. One or more synchronous characters are transmitted to confirm clocking before each packet of data is transmitted. Compare to Asynchronous Transmission.

T

T1 Transmission: A standard transmission speed of 1.544M bps that may be used in its full bandwidth, or as narrower channels called "fractional T1" carriers.

TCM (Trellis Coded Modulation): An error correction method that allows the receiving modem to tell if a signal element is in error, based on the value of the preceding signal elements. Each signal element is assigned a coded binary value representing the element's phase and amplitude.

Terminal: The screen and keyboard device used in a centralized computing environment for interactive data entry. Terminals have no "box", which is to say they have no file storage or processing capabilities.

Terminal emulation: Allows a PC to access a mainframe computer by generating and accepting data like a "dumb" terminal.

Threshold: A value or condition which, when reached, triggers an event.

Toggle: Alternate back and forth between two states.

Tone dialing: One of two methods of dialing a telephone, usually associated with push button phones. Compare with pulse dialing.

Transistor: A semiconductor device used to amplify a signal, or open and close a circuit. In digital computers, it functions as an electronic switch.

TSR (Terminate and Stay Resident): A software program that remains active and in memory after its user interface is closed. Similar to a daemon in UNIX environments.

Twisted pair wiring: A type of cabling with one or more pairs of insulated wires wrapped around each other. An inexpensive wiring method used for LAN and telephone applications, also called UTP wiring.

U

UART (Universal Asynchronous Receiver/Transmitter): A chip that transmits and receives data on the serial port. It converts bytes into serial bits for transmission, and vice versa, and generates and strips the start and stop bits appended to each character.

UNIX: A multi-user, multitasking operating system, first developed by AT&T in the 1970's. It now runs on a wide variety of computer systems from micro to mainframe, and is controlled by UNIX System Laboratories (USL)**.**

UTP (unshielded twisted pair): Telephone-type wiring.

V

V.21: The CCITT modulation standard for 300 bps, full-duplex transmission over dial-up lines.

V.22: The CCITT modulation standard for 1200 bps, full-duplex transmission over a dial-up or 2-wire leased line. This is not common in North America.

V.22*bis*: The CCITT modulation standard for 2400 bps, full-duplex transmission over a dial-up or a 2-wire leased line.

V.23: The CCITT modulation standard for 75/1200 bps, half-duplex transmission over dial-up lines. This is not common in North America.

V.24: The CCITT hardware interface specification for interchange circuits between the DTE and DCE.

V.25*bis*: A dialing command set developed by the CCITT for both synchronous and asynchronous devices. Since V.25*bis* does not provide any modem configuration commands, it is primarily used for its synchronous dialing commands, while the "AT" commands are used for asynchronous dialing and for modem configuration.

V.26: The CCITT modulation standard for 2400 bps, full-duplex transmission over 4-wire leased lines. Primarily for synchronous use. Not common in North America.

V.27: The CCITT modulation standard for 4800 bps, full or half-duplex transmission. Primarily for synchronous use. Not common in North America. V.27ter is used by Group 2 fax-modems for 4800 bps fax transmission.

V.29: The CCITT modulation standard for 9600 bps, 2-wire (half-duplex) or 4-wire (full-duplex) transmissions, primarily over leased lines (synchronous or asynchronous). V.29 is used for Group 3 fax transmissions.

V.32: The CCITT modulation standard for synchronous or asynchronous input to be transmitted at 9600 bps over the PSTN. V.32 operates in half- or full-duplex mode.

V.32*bis*: The CCITT modulation standard for synchronous or asynchronous input to be transmitted at 14,400 bps over the PSTN. V.32*bis* operates in half- or full-duplex mode.

V.32terbo: An AT&T recommendation for synchronous or asynchronous input to be transmitted at 14,400 bps over the PSTN. V32terbo operates in half- or full-duplex mode.

V.32: The CCITT modulation standard for synchronous or asynchronous input to be transmitted at 9600 bps over the PSTN. V.32 operates in half- or full-duplex mode.

V.33: A CCITT modulation standard for 14,400 bps synchronous transmission over a 40wire leased line.

V.35: The CCITT hardware interface specification commonly used by DSU/CSUs and other high-speed devices.

V.42: A CCITT recommendation for error-control hardware on a modem that accepts asynchronous input. V.42 recommends for manufactures to implement LAP-M and makes a provision for MNP-5 as a alternative because of its popularity. Most modem makers provide both.

V.42*bis*: A CCITT recommendation for data compressing hardware on a modem that accepts asynchronous input. V.42*bis* is based on a dynamically updated dictionary that looks up common strings and replaces the strings with code words. This reduces the amount of characters actually transmitted. V.42*bis* has been found to be most effective for file transfers that contain long strings of repetitive information and least effective for short strings of unique data.

V.54: The CCITT recommendation to standardize Bit Error Rate Testing (BERT) and Loopback testing (Local Analog and Digital Loopback, as well as Remote Analog and Digital Loopback).

VRC (Vertical Redundancy Check): An error checking method that generates and tests a parity bit for each byte of data that is moved or transmitted.

W

WATS (Wide Area Telephone Service): A discounted long-distance calling plan that allows calls in or out. The popular 800 numbers are WATS lines in. The calls are charges to the holder of the 800 number at a discounted rate.

Workstation: Traditionally a dumb terminal connected to a host. However, with the advent of LANS and WANS, PCs that are connected to a LAN are now called workstations too, even though they are capable of independent processing. A workstation is simply an input/display device through which a user accesses a resource.

X

X.121: CCITT's recommendation for unique addressing of each DTE connected to a communications network throughout the world. X.121 uses fifteen digits: a one-digit prefix, a four-digit DNIC number (which identifies the country and PDN), and a ten-digit national terminal number.

X.21: CCITT's recommendation for a 15-pin, digital interface. It is not widely accepted, because of the analog loops still prevalent in data communications. For this reason, CCITT introduced the X21*bis* standard for use with synchronous modems.

X.25: CCITT's definition of a three-level packet-switching protocol to be used between packet-mode DTEs and network DCEs. X.25 corresponds with the lower three/four layers of the seven layer OSI model.

X.28: CCITT's definition of asynchronous commands used by a local ASCII terminal to configure an X.25 PAD.

X.29: CCITT"s definition of packetized commands sent to configure a remote PAD via an X.25 link.

XModem: A widely used asynchronous file transfer protocol. Programs typically use both the older version, checksum, and the new version, CRC method, to detect errors. If CRC is not present at the other end of a file transfer, then it will use checksum.

Y

YModem: An asynchronous file transfer protocol that improves speed by transmitting 1,024-byte (1K) blocks and batch file transfer.

Z

ZModem: An asynchronous file transfer protocol that is more efficient than XModem. It sends file name, date and size first, and responds well to changing line conditions due to its variable length blocks. It uses CRC error correction and is effective in delay-induced satellite transmission.

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